ELECTRICAL TIMES

THURSDAY
31 DEC.
1953
NINEPENCE

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YEAR MADE
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MAZDA LAMPS.

THE BRITISH THOMSON-HOUSTON CO. LTD.
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BENJAMIN REGD.

deep bowl reflectors

for Quality Lighting

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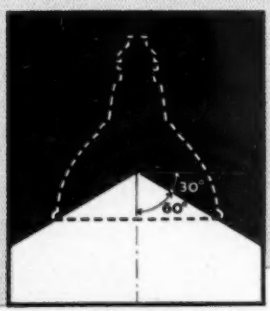

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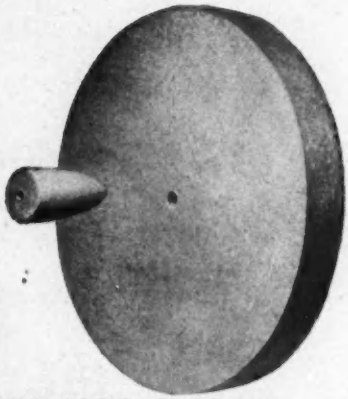

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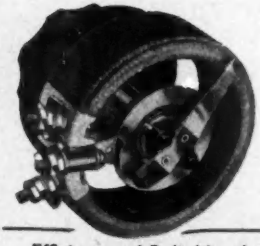

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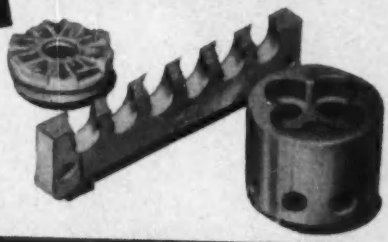

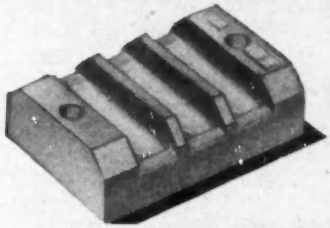

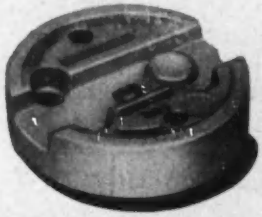

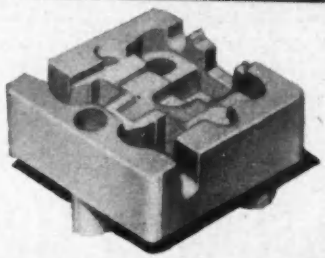

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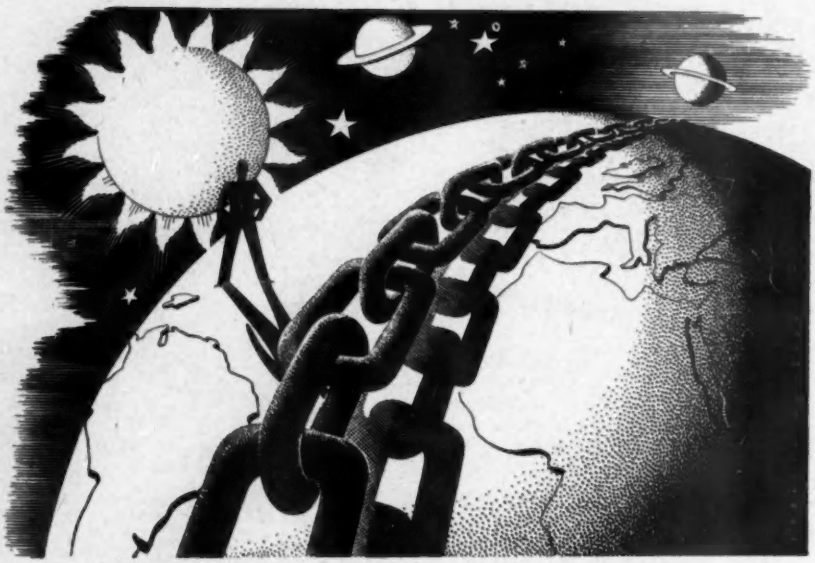

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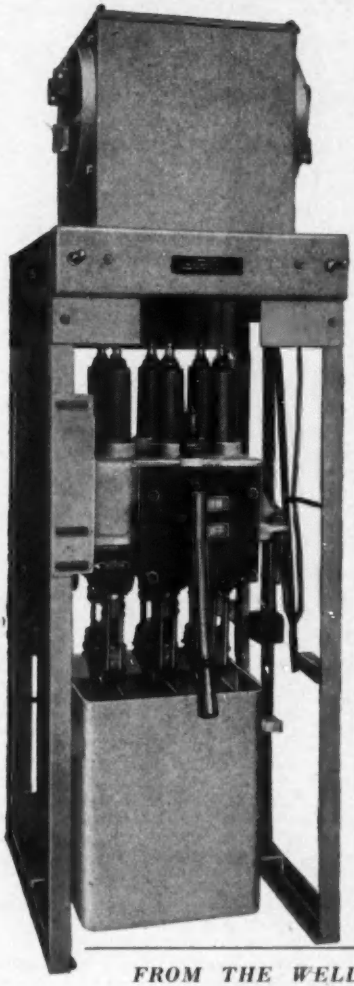

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without interrupting supply in ring main units

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. . . to enable complete isolation of the switch for ease of inspection and maintenance (with no interruption of supply in ring main units)

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. . . so that electro - magnetic forces assist the closure of the switch under through-fault or short-circuit conditions (it cannot possibly be forced open)

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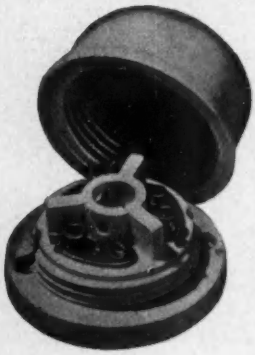

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Top Entry
Porcelain Switched
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INTERNAL MICRO GRINDING

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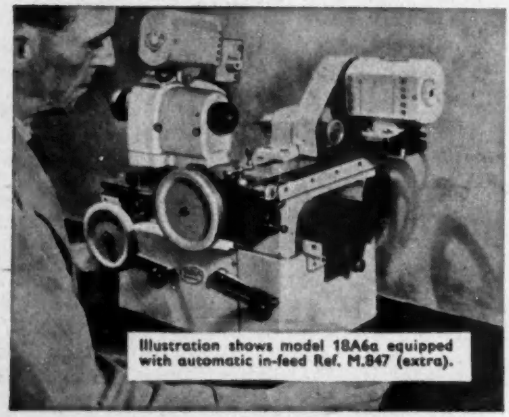

Illustration shows model 18A6a equipped with automatic in-feed Ref. M.847 (extra).

This new machine can grind holes which—from a production view point—have hitherto been regarded as entirely outside the accepted range of internal grinding. Holes of no more than .010 in. can be ground, but the design of the machine is such that bores of ¼ in. and over can also be handled.

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Hydraulically operated table motion with infinitely variable speeds; automatic in-feed if desired.

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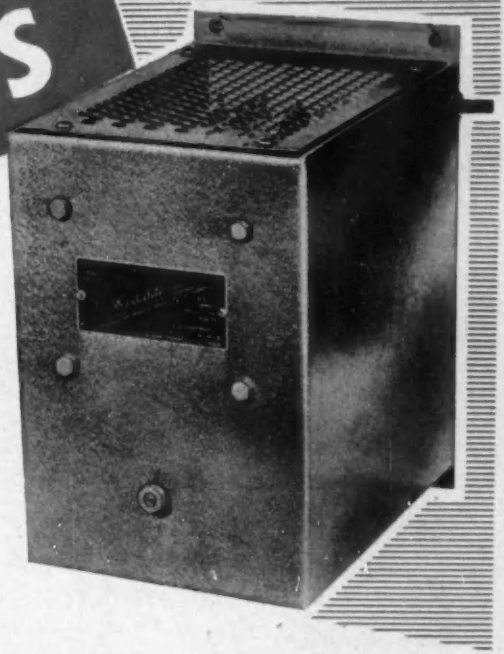

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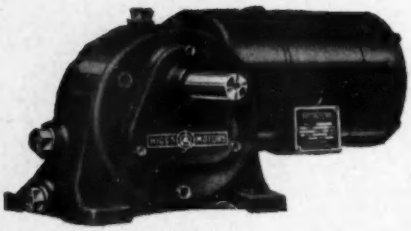

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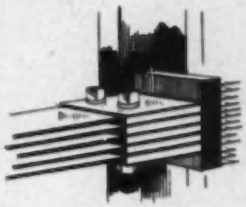
Some

BICC PRODUCTS *for the* **ELECTRICAL INDUSTRY**

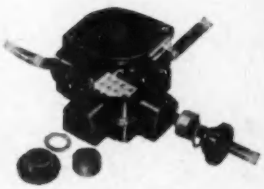
We illustrate here a few examples from the wide range of BICC Cables and associated equipment for the electrical industry. Technical information on the items shown here is contained in the Publications indicated; the complete list of BICC products is given in Publication No. 215. All publications are available on request.

Resilient Moulded Connector Units. Publication No. 305

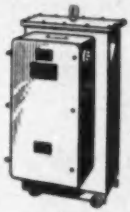
Mass Impregnated Non-Draining Cables. Publication No. 308



Copper Busbars. Publication No. 304



Industrial Wiring System. Publication No. 323

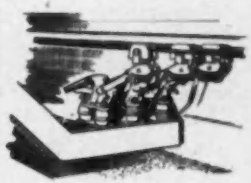


Power Capacitors. Publication No. 242

Detachable Fused Tee Box. Publication No. 288

Rubber Cables & Flexibles. Publication No. 269

Aluminium Claw Type Cable Cleats. Publication No. 287



Current Collector Equipment. Publication No. 271

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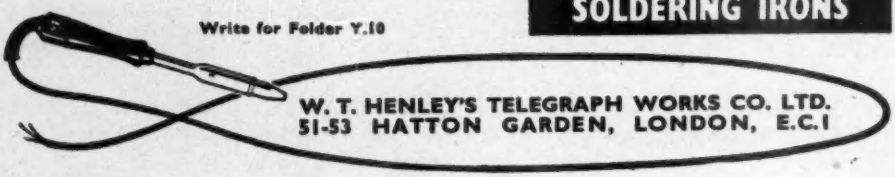

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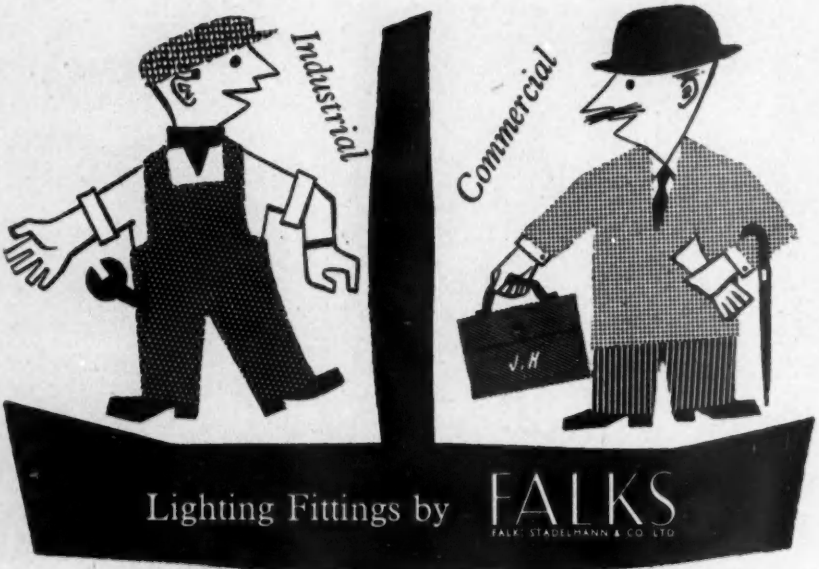

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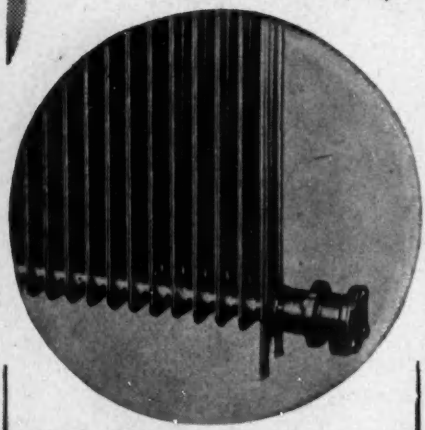

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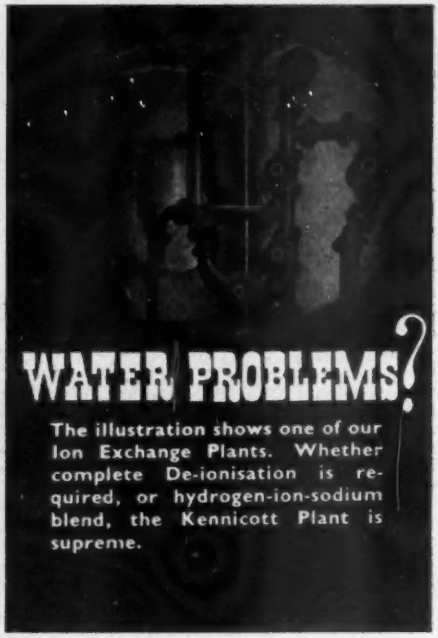

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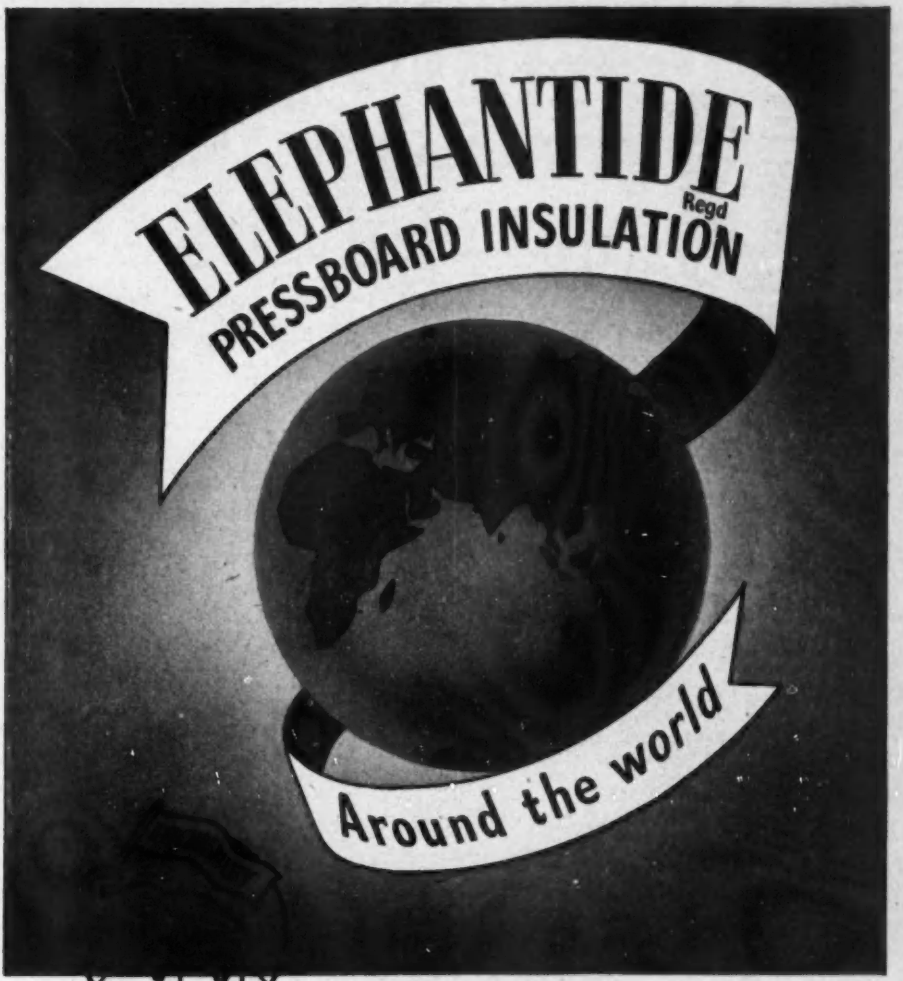
The illustration shows one of our Ion Exchange Plants. Whether complete De-ionisation is required, or hydrogen-ion-sodium blend, the Kennicott Plant is supreme.



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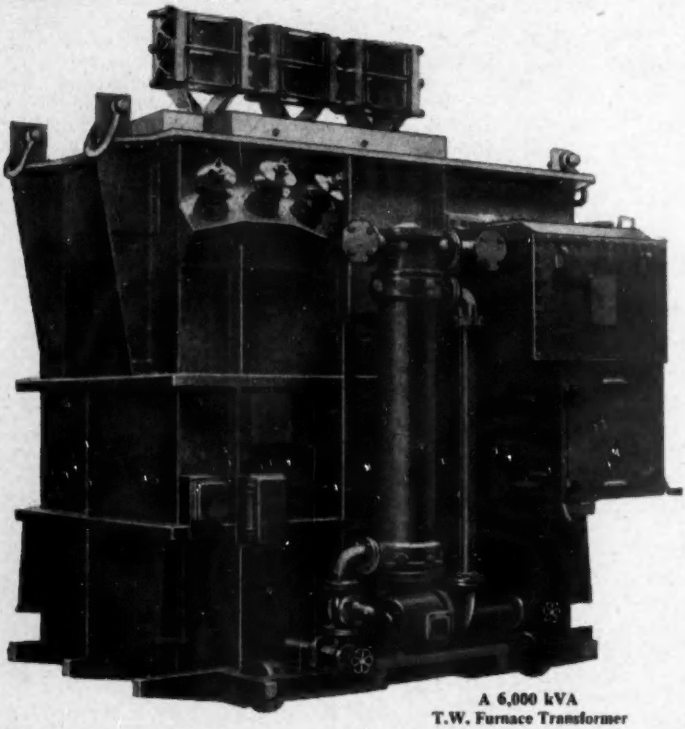

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T.1

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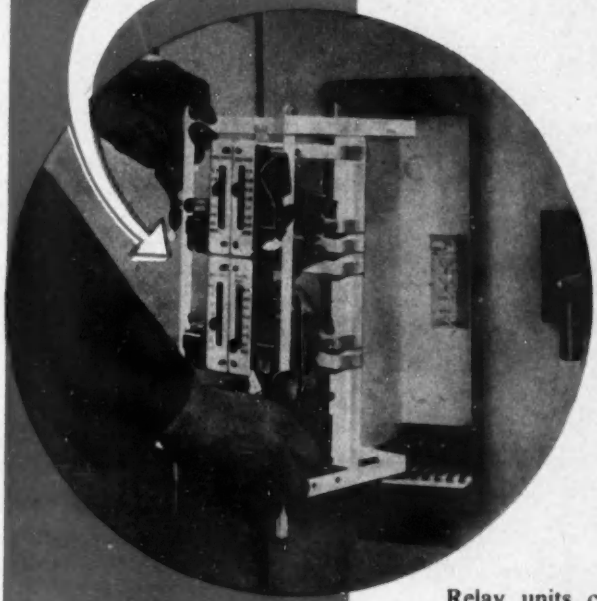

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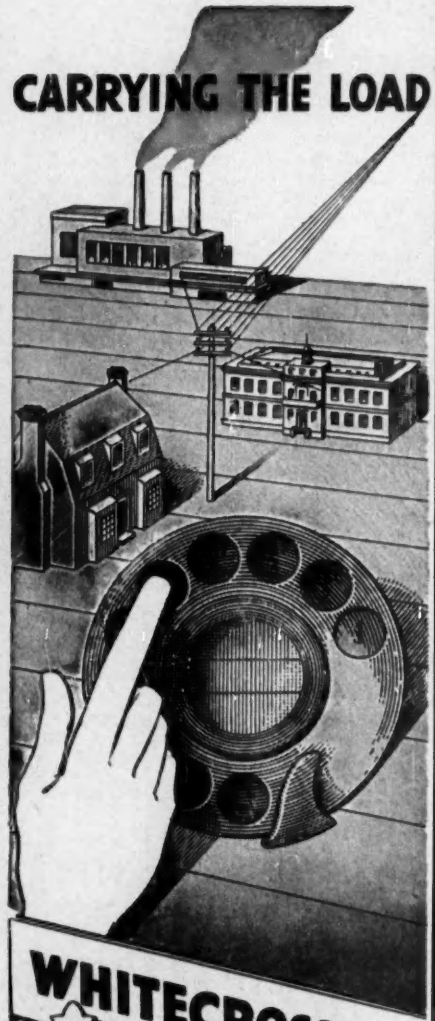

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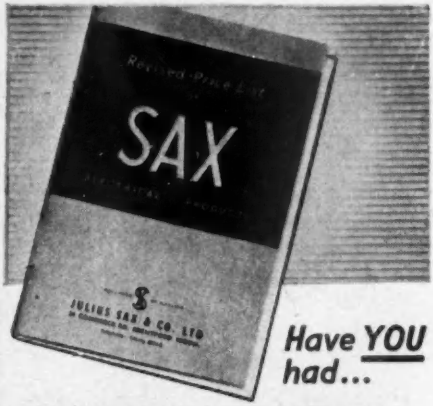

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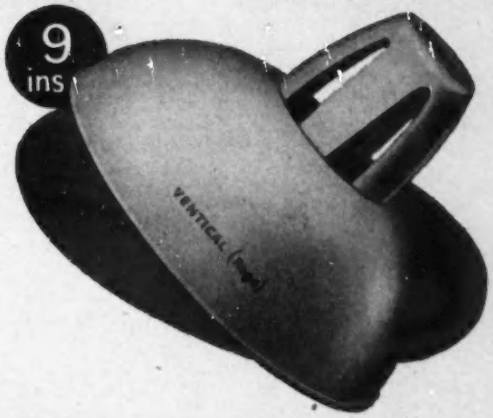

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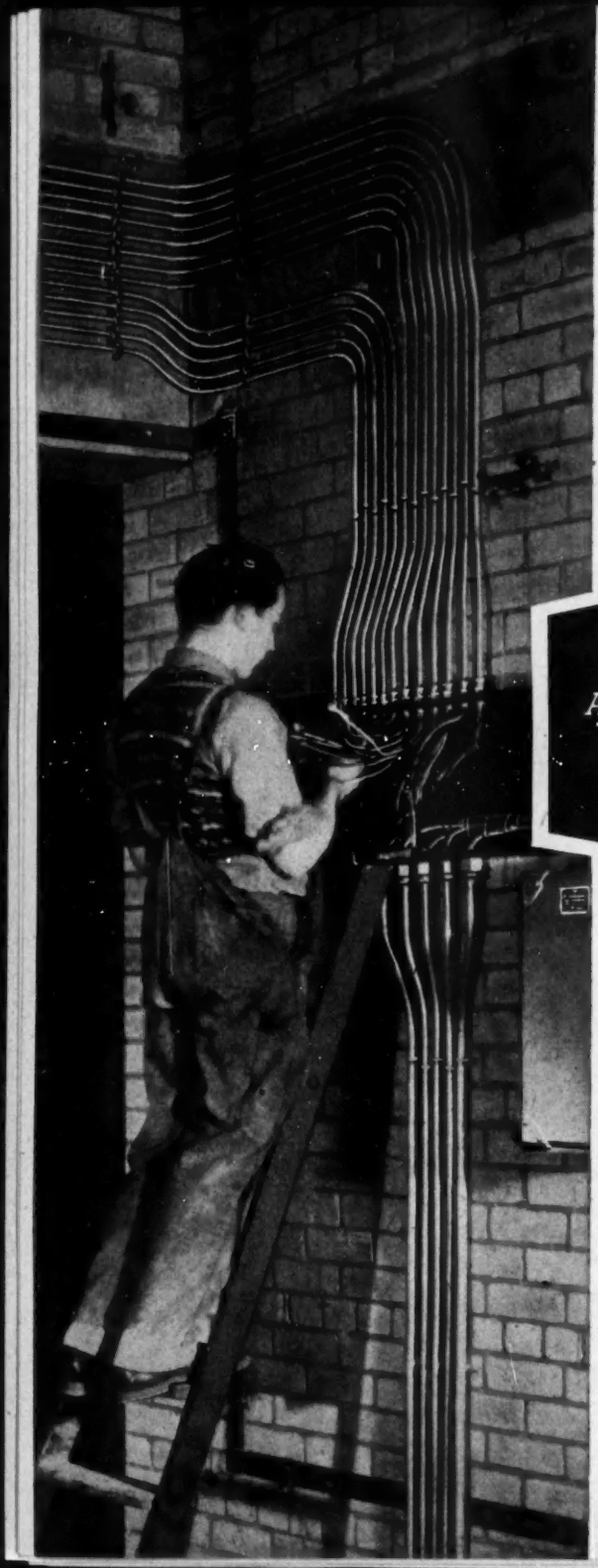

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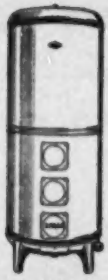

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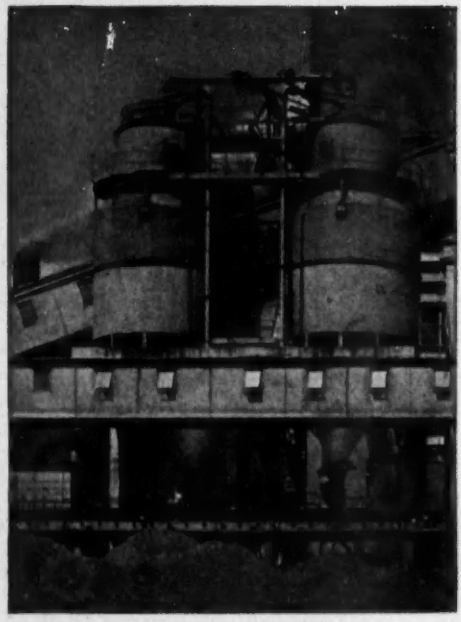

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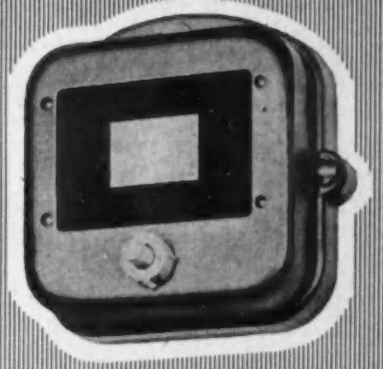

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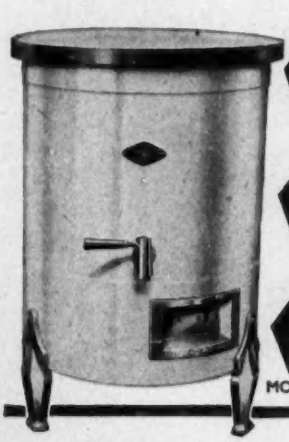

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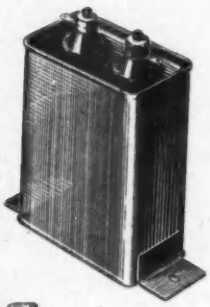

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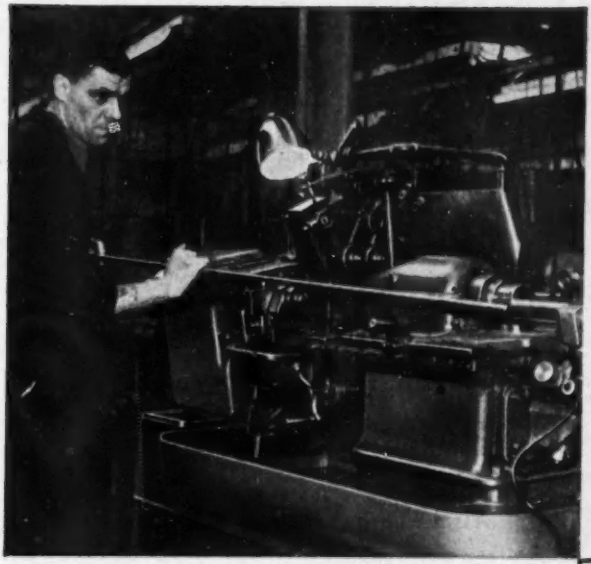

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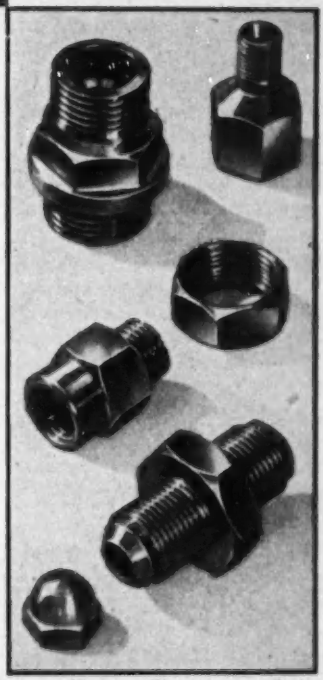

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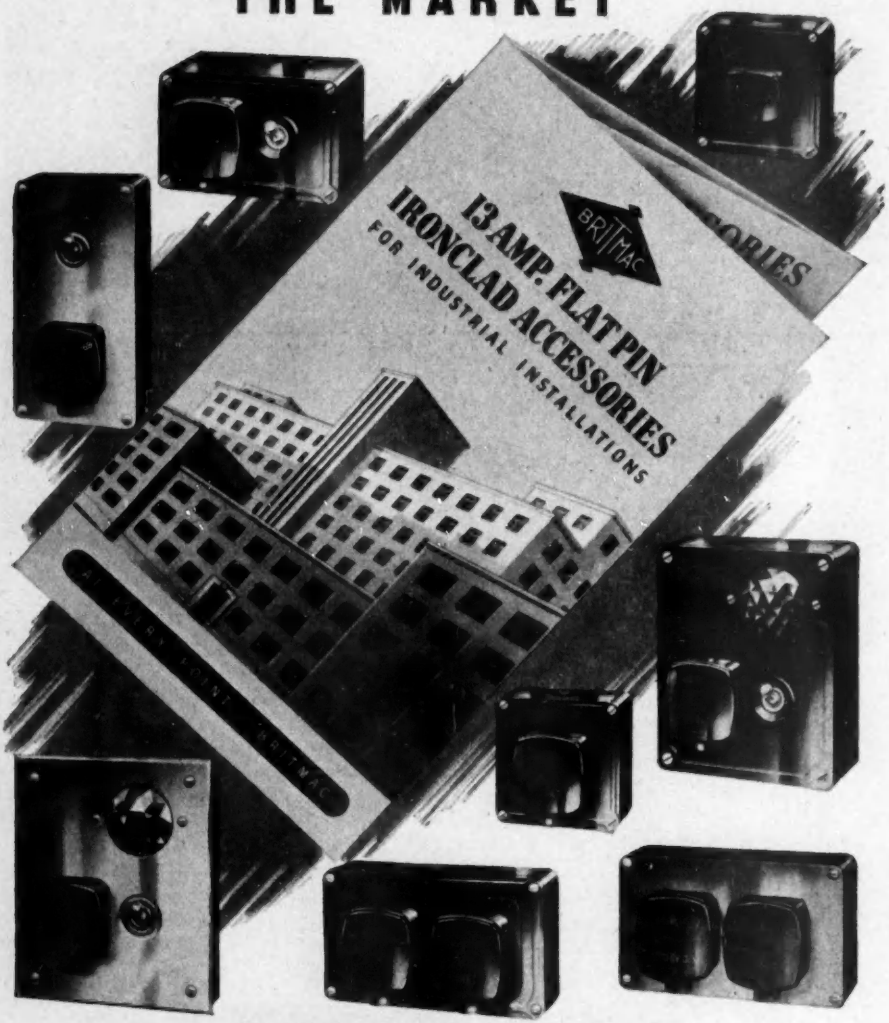

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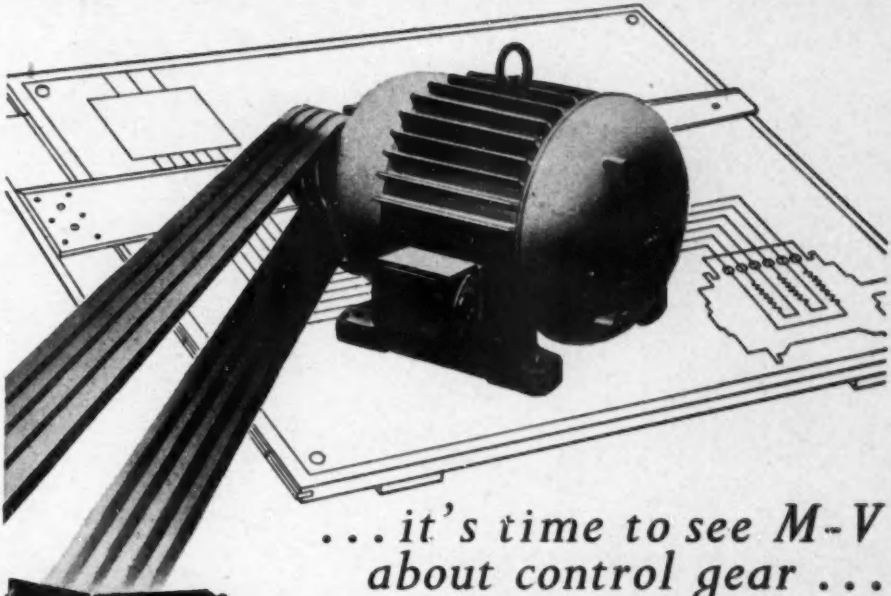

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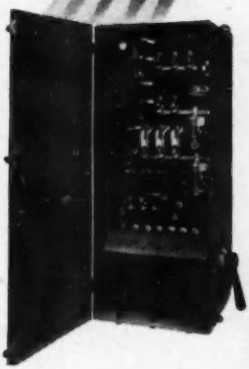

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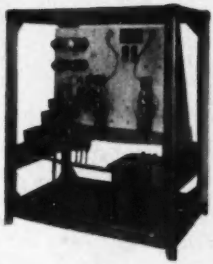

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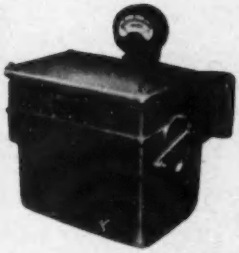

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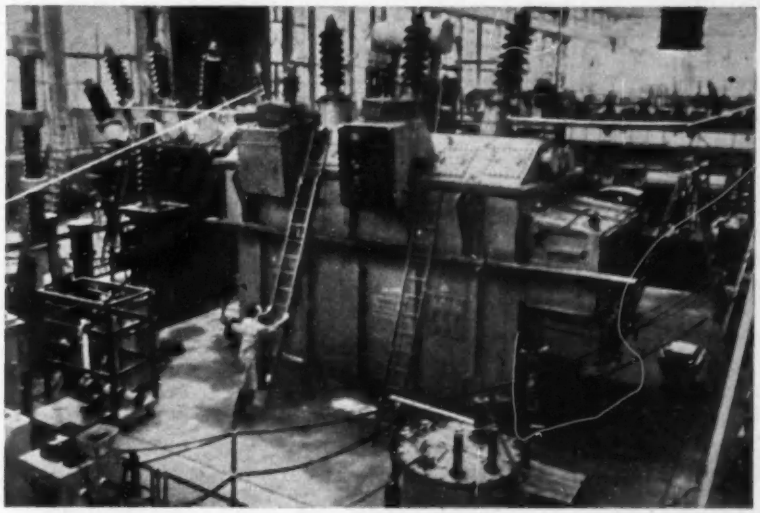

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P.5325

It's a point of good design... 12

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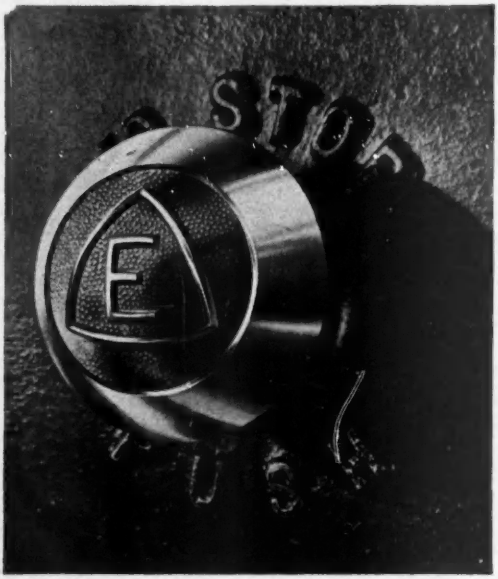

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ELECTRICAL TIMES

Volume 124 No. 3243 31 DECEMBER, 1953

PUBLISHED EVERY THURSDAY

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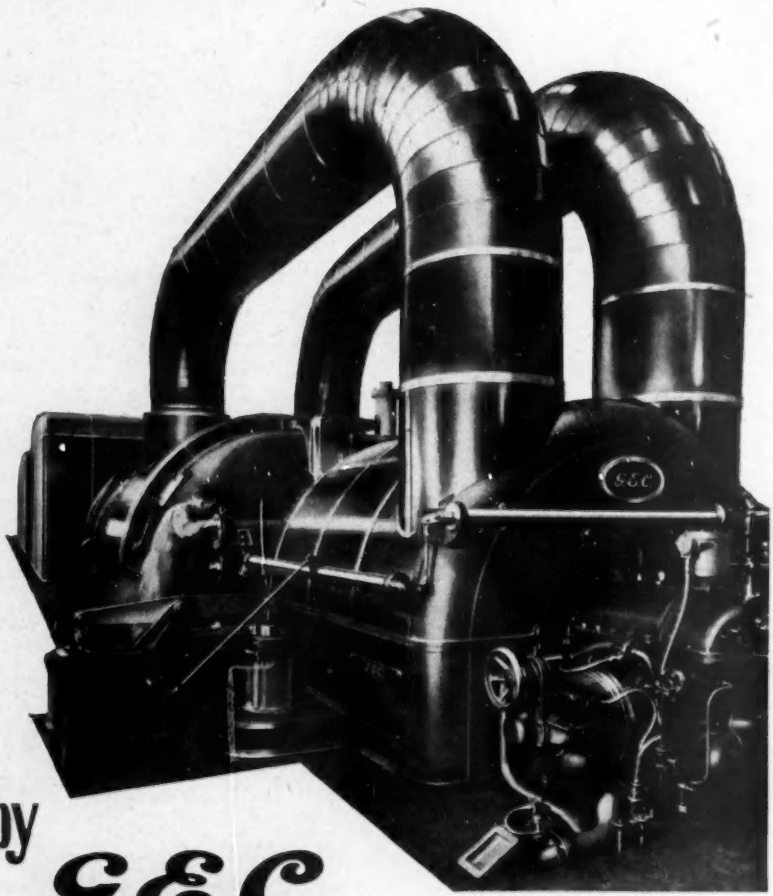


by G.E.C.

The 60,000 kW hydrogen-cooled turbo-alternators recently installed at Uskmouth Power Station, Newport, Mon., are achieving the highest efficiency ever known for power generators of this size operating at a steam pressure of 900 lb. per sq. in. and at a steam temperature of 900° F.

The heat consumption figure at full output officially confirmed by the British Electricity Authority is 9,027 B.Th.U. per kWh.

THE GENERAL ELECTRIC CO. LTD., MAGNET HOUSE, KINGSWAY, LONDON, W.C.2

Editorial

TECHNICIANS IN ASIA

NEARLY four years have passed since the Commonwealth Foreign Ministers' meeting at Colombo evolved the plan that took that city's name. Since then, the development of south and south-east Asia, which it is the Plan's aim to foster, has progressed apace. The Second Annual Report of the Consultative Committee which administers the plan, is able to report the initiation of important schemes in every country, including in most cases sizeable electric power projects. It is these large-scale plans which take the eye in the report; it is, however, necessary to emphasise what has sometimes been a painful experience with similar schemes. A hydro-electric station involving the damming of some mighty river will one day become manifest in the widespread activity of electricians wiring small houses, and maintenance men adjusting control equipment in electrically powered factories. The training of such men must receive attention now, if efficient use is to be made of the power that technological skill and heavy financial investment will provide. There is ample evidence of awareness of this fact in the Report of the Council for Technical Co-operation in South and South-East Asia, which is annexed to the main Report. There it is stressed that ". . . the medium and lower grade technicians . . . the whole range of non-commissioned officers in every branch of industry and administration, whose role is just as important as that of the qualified professional men" can be trained only in their own countries. The long-term advantages of accustoming technicians to work with British products from their earliest days cannot be over-rated, and British firms should lose no opportunity of assisting in the provision of such training by such means as the loan of equipment for use in the technical colleges which will have to be set up.

COUNTRY COURSE

FARM electrification has passed this year from an artificially restricted theme for electricity supply salesmen to a campaign which can be conducted with the uninhibited enthusiasm that was the characteristic of electrical development in the 1920s. That has been the effect of the Government's decision to permit electricity boards to increase their expenditure on bringing electricity to the countryside, and to allow them to undertake the promotional work that can encourage full use of it. There is renewed evidence of the boards' intention of grasping this opportunity in the reported overwhelming number of applications for admission to the vacation school in Rural Electrification which E.D.A. has organised at the University of Nottingham next week. The course will cater for area board staffs, and judging by the published programme, it will give them some hard practical advice on what will be required in this uphill task of selling electrification to the farmer. But the value of the course will not end with the lectures. There is a generous allowance of time for discussion, and with representatives from overseas and from every electricity board except London present, useful cross-fertilisation of ideas seems likely. So well conceived a course, with E.D.A. actively back on its job of encouraging selling, provides a fine beginning for the supply industry in 1954.

LINES IN THE COUNTRY

IN the early stages of planning an engineering project that must perforce take several years to complete, it is difficult to secure that atmosphere of urgency which can eventually spur-on work on site when steel and concrete have begun to acquire meaningful shape. As Sir John Hacking pointed out recently, the long process of obtaining planning permission can do much to

dampen this desirable sense of urgency; leisurely obstructionism on one side of the table by enthusiasts for amenities is frighteningly effective in inducing an enervating feeling of frustration in engineers who want to get on with the job. These reflections are prompted by the appearance recently of the fourth annual report of the National Parks Commission, which under its terms of reference is frequently involved in these delaying proceedings. An appendix to that report lists several cases in which plans have been altered by the Central Authority and by Area Boards to fit in with the Commission's recommendations: and some, almost farcical, where various objecting bodies have been unable to agree amongst themselves who is to make some apparent sacrifice in scenic beauty to enable the country as a whole to have the power it needs. It is apparent from this and other reports that the supply industry is doing its best to meet reasonable amenity objections. The enthusiasts for natural beauty should in turn moderate their sensitiveness, and so facilitate the provision of the amenity of plentiful electricity.

LAMP PRIORITIES

SEVENTY-FIVE years ago this month, that remarkable inventor and scientist Sir Joseph Swan exhibited a carbon filament electric lamp at a meeting of the Newcastle-on-Tyne Chemical Society. The carbon lamp had been known for some years, but no practicable method of preventing wasting of the filament and blackening of the containing bulb had been available until Swan hit upon the scheme of keeping the carbon incandescent while the bulb was evacuated. All this in 1878: yet the United States of America will shortly be proclaiming that their own genius, Thomas Alva Edison, invented the electric lamp seventy-five years ago. The mixed story behind this long-drawn controversy will stand repeating. In October 1878 Edison claimed to have solved the problem of small electrically heated light sources; but he was working with a platinum wire spiral as the element, and his claim proved premature. However, a year later he obtained a British patent for a carbon filament lamp, using an evacuated glass container. Swan, on the other hand, considered that his public exhibition of such lamps in 1878 had precluded him from making a patent claim himself for the simple lamp. His patent, when it came, dealt with the great practical improvement brought about by using cellulosed thread as a filament—an invention that in fact prevailed in practice over Edison's carbonised bamboo. While tribute is due to both men, one must deplore the over-accentuation of the claims of one of them, the more so as he was in fact not the first!

CONVENTION TALKING POINT

WHEN the familiar cream-bound "Proceedings" of the British Electrical Power Convention appeared on our desk the other day, the first thing we looked for was the written contributions to the discussions, which were promised when the various sessions at Torquay were cut short. They proved to be worth the search, though it took some little effort to recall the context in which they were made. How much more satisfactory it would have been to have heard them at the Convention itself; yet the technical programme there was more than comfortably full. What improvements, then, are possible for Eastbourne next June? It seems that either fewer papers must be presented—as Captain Donaldson suggested at Torquay—or that more time must be found for discussing them. On the whole, the second alternative seems favourable, as there will always be subjects that are specially suited to the B.E.P.C. In certain quarters it is urged that the B.E.A. private meeting should be postponed until the final day of the Convention, and this would be one way of gaining extra time for discussion. Another possibility is the adoption of the *rapporteur* system with an independent speaker summarising all the papers presented at a given session. The result should be fuller discussions, time for authors to reply to them—and a better Convention.

Meteor

About Ourselves!

WHILE it is right and proper that editorial activity should be modestly cloaked beneath the anonymous "we", the adoption of an enlarged quarto format from our next week's issue offers an excuse for us to talk about some of the features, new and old, that it will contain.

The size of page may appear somewhat overwhelming at first, as it did to us, but it permits the use of a larger type, more kindly to the eyes, with illustrations and diagrams of a size more quickly comprehended. And if something is lost in the convenience of the pocket edition, this should be more than compensated for by the easier assimilation of technical and news features. The larger page also is more in keeping with the dignity of the electrical industry; particularly is this important overseas, where the full-size journals of competing countries circulate. Furthermore, the introduction of an all-over four-colour cover each week, similar in style to that which we have hitherto used only for special issues, will provide added appeal.

Of the new features that we shall be introducing in our first issue in January one will be a monthly contributed article "Around the Trade". This will discuss informally topics which concern the manufacturer, wholesaler, contractor and retailer. We hope it will provide for the trade something akin to that which "Notes on Wiring" offers to those concerned with wiring.

It has long been recognised that with the changing conditions of the industry "The Buyer's Column" had grown to cover too wide a field. Accordingly the title will be changed and will deal exclusively with products and information for the electrical trade. Industrial equipment which often requires somewhat longer treatment than has hitherto been possible to accord to it, will now be described under a separate heading. In addition, later in January we shall be publishing a special section dealing with the use of electricity in industry.

Some months ago we revised our method of reporting the financial results of companies to present in simple tabular form their basic trading figures for the last five years, where available. We are now introducing a short weekly commentary on financial matters affecting the electrical industry, written by a correspondent well known in city circles. This we hope will provide a useful supplement.

The new four-colour cover

One other innovation is to be made. Under the heading of "Sayings of the Week" we shall be reproducing interesting and important statements that have been made in speeches that, for one reason or another, are not reported at length.

In addition to these new features, all the existing ones, familiar to readers, will be retained. On the present special occasion we may be excused in drawing attention to the unique character of "Overseas News", which is based on our own electrical news service from the principal overseas markets.

It is now nearly thirty years since we started the free inquiry department. During that time we have built up a system of records, including a card index which must surely be the largest electrical trade reference system in the country. This symbolises our tradition and our policy to serve our readers in every way possible to the limits of our ability, and we hope in launching the new enlarged format our readers will feel we are continuing in this spirit.

Power Development in Norway

INCREASING HYDRO EXPLOITATION TO SUPPLY EVER GROWING DOMESTIC DEMAND

By Our Norwegian Correspondent

SINCE 1945 Norway has harnessed more hydro-electric power than in the whole period between the two wars. The rate at which new generating capacity is being installed is still increasing. This year (1953) the amount of new installed capacity will be about 330,000 kilowatts, the biggest amount achieved in any year either before or after the war. This raises Norway's overall hydro-electric generating capacity to rather more than 3,600 MW compared with 2,110 MW in 1939. The output of electricity has increased even more than generating capacity. Last year's output was 18,900 million units compared with 10,500 million in 1939.

Despite this expansion, only about 1/6th of the utilisable water-power has so far been harnessed. Although the amount of electricity used in Norway is already the highest of any country in the world (5,700 units a year per head in 1952 compared with 4,300 units a head in Canada and 3,000 units a head in Sweden and U.S.A.), the demand for electricity is still far from satisfied. Industrial concerns can take all the additional electricity that becomes available, and domestic demand remains very pressing. At present 88% of the population is supplied with electricity, a proportion which it is hoped to raise to 94% in the next four years. A most important factor is the demand for electricity for domestic heating. Because of the high price of imported solid fuel, and the low price of electricity, electric heating is strongly favoured, but the use of electricity for domestic heating has to be restricted owing to other competing needs.

The expansion of the electricity supply is nevertheless proceeding unabated. At present fifty power plants are under construction and another thirty-five are being extended, quite apart from numerous small

Machine room of an underground station 300 ft below the surface

This is a view looking down one of the tunnels carrying the pressure pipes to an underground power station

plants of under 1,000 kilowatts. When all these new constructional works and extensions are completed, probably by the beginning of 1958, rather more than 5,000 MW of generating capacity will be available altogether. About 268 MW will be ready next year, and in 1955 (a new peak year for new installed capacity) 484 MW. Among the more important of the hydro-electric projects now building are the Vinstra plant (200 MW) in East Norway, the Aura plant (285 MW) in West Norway, and the Røssåga plant (120 MW) in North Norway. The two latter plants are both principally designed to supply big new industrial undertakings—the new aluminium plant (Norway's biggest) at Sunndalsøra, West Norway, and the new steel plant (again Norway's biggest) at Moi i Rana, North Norway.

Restrictions on Building

The investment in hydro-electric development in Norway is about £25,000,000 a year, a considerable slice of total national investment. Electricity expenditure has had to be adjusted to other competing needs in the post-war period of reconstruction and economic development, but generally speaking it has been given top priority, the authorities recognising the key role which electricity plays in the Norwegian economy. The chief limiting factors have been materials, equipment and labour. The supply of materials and equipment (partly home produced, partly imported) has become much easier, and the chief consideration now is the supply of skilled personnel.

It is pointed out in a Norwegian Government document published recently that whilst industry's consumption of electricity has gone up in absolute figures since before the war, its relative share has gone down, from 75% in 1938 to 67% in 1951.

Domestic Consumption

Domestic consumption has more than doubled and in 1951 was 32% of overall consumption compared with 24% in 1938. The rise in domestic consumption (which involves severe rationing in Oslo and other places in winter) is obviously linked with the low price

Water valve gear installed in pipeline underground

of electricity and the high price of other fuel. The price of electricity has hardly increased at all since before the war, and while a price increase would help to balance supply and demand, the authorities are deliberately avoiding such a solution on the social ground that electricity, like, say water, should as a basic necessity, be available to all without economic discrimination. The ever-mounting demand for electricity for heating does, however, raise serious problems, and in new dwellings all-electric heating systems are not being permitted. Ultimately, with the development of the hydro-electric supply, it is hoped that up to 80% of the nation's domestic heating needs can be met by electricity, and the Norwegian Electricity Board has intimated that this can be done over a period of about 12 years. Obviously, however, it would be uneconomic to plan for 100% electric heating: a great deal of generating capacity would have to be installed which would be employed only during brief periods of exceptionally low temperatures.

Interconnection

Much importance is being attached to the development of regional and inter-regional grids so that localised shortages of power can be met by transfer from plants in other districts with a surplus. This is particularly important in Norway, where there can be great variations in rainfall in particular regions in particular years. The development of long-distance transmission lines is also helping to keep down power costs because it makes it possible to exploit water-power resources in remote spots which are economically cheap to harness but which, in the past, were considered too far from the centres of consumption.

Underground Plant

A feature of Norway's hydro-electric development is that all the major projects started since the war have been underground, or more accurately under-mountain schemes. Supply tunnels and generating shops have been blasted out of the rock. Quite apart from the security angle, this laborious process of power plant construction has not notably increased initial costs, whilst long-term maintenance costs are likely to be appreciably lower than for traditional surface plants. A considerable skill in this type of construction has been acquired, and blasting and allied operations are being steadily speeded up.

Concurrent with the expansion of Norway's hydro-electric resources is the development of the nation's manufacturing capacity for generating equipment. The manufacturing capacity of factories making electric generators is now reckoned at 160 MW a year, or roughly half the annual requirement. The manufacture of transformers and other equipment is now also sufficient to meet most of the demand. The output of cables is now about 18,500 tons a year against 7,000 tons in 1938. For high-tension cable there is still a shortage which has to be met by import, but the smaller-calibre cable output is more than adequate and indeed is sufficient to supply an export market.

RUSH-HOUR IN THE TUBE

AN experimental "rush-hour bench seat" to provide extra accommodation for tube car travellers and to ease boarding and alighting is being tried out by London Transport on the Northern Line.

A tube car has been fitted with four L-shaped bench seats, each located at bar stool height alongside one of the pairs of double sliding doors. The bench seats are upholstered and leather covered. Each replaces an existing two-passenger seat, but provide instead a rush-hour "perch" for three passengers and in addition provide four extra square feet of standing room for other passengers. The car with the rush-hour bench seats can as a result now accommodate sixteen extra passengers in all.

Experimental Bench-seats in tube train

ELECTROCHEMICAL GENERATION

—A Review of Progress In the Development of Fuel Cells for Direct Production of Electricity

By a Correspondent

THE electrochemical generation of electrical power dates from 1800, when Volta showed that a continuous source of electricity could be provided by a simple and inexpensive cell. The chemical energy of the cell put into reactants is turned into electricity when the cell is discharged.

Interest in the potentialities of the voltaic cell as an economic source of power was diminished by the advent of the dynamo in the second half of the nineteenth century. Yet the principle continues to be used for storing power on a limited scale, a simple application being the ordinary dry battery, which derives its electrical energy from the oxidation of the zinc element. In theory, very high efficiencies can be obtained from primary cells. On the other hand, a power station can never be 100% efficient, since the thermal energy of the fuel is utilised in the inherently inefficient heat engine.

In recent years the high cost of coal and the expanding demand for electrical power have led to a revival of interest in the development of fuel cells suitable for the economic generation of electricity. To compete economically with established methods for the production of electrical energy, fuel cells would have to be more than 40% efficient. Other essential requirements are robustness, simplicity, cheapness, and the ability to supply adequate power for long periods.

Interest in the electrochemical generation of power was never entirely dispelled by the success of other methods. During the past fifty years, at least a hundred designs of fuel cells have been developed, but with one or two important exceptions, none of them gave any promise of being suitable for large-scale operation. Nevertheless, there are encouraging indications that fuel cells may find successful large-scale applications within the next decade.

Basis of the Fuel Cell

In general, fuel cells involve reactions either between carbon and oxygen, or between other chemical substances. The carbon-oxygen type is known as a direct fuel cell. A direct cell, in which some form of solid carbon could be used as the anode, has obvious potential advantages. In practice, however, the application of the reaction

$$C + O_2 \rightarrow CO_2$$

to an electrochemical cell has proved very difficult. Neither carbon nor oxygen ionises very readily, with the result that an electrochemical cell is formed by complex reactions occurring at the positive and negative electrodes. These reactions are too slow at normal temperatures for a carbon-oxygen cell to be used as a fuel cell.

Because of the difficulties presented by direct cells, attention has been directed to indirect cells using, for example, carbon monoxide or hydrogen as the fuel. The reaction between carbon monoxide and oxygen is also difficult to apply to a cell and any process based on this reaction would have to be operated at high temperatures.

On the other hand, the reaction

$$2H_2 + O_2 \rightarrow 2H_2O$$

occurs quite readily in an electrochemical cell, representing the reverse process to the electrolysis of water, and this process has been applied to the construction of room-temperature fuel cells.

Early Work

As early as 1893, Sir William Grove showed that, with dilute sulphuric acid as the electrolyte and electrodes of activated platinum, hydrogen and oxygen would react to yield a small electric current. In 1898, a similar cell was developed by Mond and Langer, who achieved a current density of 6 amps per sq ft of electrode at an efficiency of nearly 50%. Further progress by these investigators, however, was prevented by the high cost of the platinum electrodes.

Another method of using carbon and oxygen indirectly is offered by redox cells, in which ferrous and ferric iron are used as the electron carriers. In this type of fuel cell an atom, or molecule, exists in two different states of oxidation, and according to the relative concentrations of the reduced and oxidised states, this system tends to give up or accept electrons from an inert electrode, e.g., gold or platinum. If the ratio of concentrations of ferric ions to ferrous ions

is high at one inert electrode and low at another, a potential difference will be set up between the two electrodes and a current may be drawn from them. In order to maintain a current the two solutions must therefore be reduced and oxidised respectively.

When an appreciable current is being taken from any type of fuel cell, the amount of electrical energy produced always falls below that theoretically available. When the cell is operating at an appreciable current some of the energy which would otherwise be available for work is converted into heat. Possible methods of improving fuel cells will have to be related both to energy losses resulting from inefficient use of fuel for the electrochemical reaction, and to those due to inefficient conversion of the fuel used in the electrochemical reaction into electricity.

Current Research

Current research on fuel cells has recently been reviewed by R. G. H. Watson, PH.D., at Cambridge University Department of Chemical Engineering (*Direct Current, I*, 2, Sept. 1952), and also in a report by A. P. Paton, B.SC., A.M.I.Mech.E., A.M.I.E.E., of The British Electrical and Allied Industries Research Association (Ref. Z/T89).

Both direct and indirect types of fuel cells are at present in course of development in various countries. E. Gorin, of the Pittsburgh Consolidated Coal Co., recently patented a method based on high temperature operation of a direct fuel cell. This development originated from the work of Davtyan at the Academy of Sciences in Moscow. Highly reactive carbon is converted into water gas, which is subsequently oxidised in the presence of solid electrodes and electrolyte to produce electricity. The actual patent deals with a method of using the heat produced in the fuel. Government experts in the United States were reported to be enthusiastic about the ultimate possibilities of this cell. Efficiencies as high as 75% are claimed, but so far operating life is short.

Another cell of the direct type has been built by K. Bischoff at the University of Brunswick. It uses finely divided carbon as its fuel and operates at 700° C and atmospheric pressure. The actual performance of the cell is however not very encouraging, and without considerable improvement this cell is not regarded as offering economic possibilities.

In 1932, after an exhaustive study of the literature relating to fuel cells, F. T. Bacon decided that the hydrogen-oxygen system showed the most promise. Since the time of Mond and Langer the metallurgical industries had made considerable progress and there were many new metals and alloys, obtainable at reasonable prices, which could be used for the electrode material in place of costly platinum. Using electrodes of pure nickel, Bacon has made substantial progress with this system. He is at present continuing the research at Cambridge under the direction of Professor T. R. Fox, the programme being sponsored by the Electrical Research Association and the Ministry of Fuel and Power.

The Bacon Cell

In its present form, the Bacon cell consists of two porous nickel electrodes between which potassium hydroxide is circulated. The reacting gases, hydrogen and oxygen, are fed into the cell from opposite sides and an electric current is generated between the two electrodes. The performance of the cell can be improved considerably by increasing the working temperature and pressure. By the end of 1950 a cell had been constructed which would operate at 300 amps per sq ft at 0·79 volts. This represented an efficiency of 60-65% which was achieved by raising the operating temperatures to 200° C. and the pressure to 600 lb/sq in. The principal disadvantage of this cell is the very rapid corrosion of the oxygen electrode under present conditions. Attempts are being made to overcome this difficulty, but it is possible that output might have to be sacrificed for durability.

Another type of indirect fuel cell, developed by Davtyan, operates at room temperature and atmospheric pressure, using hydrogen and air. The polarisation under these conditions would normally be very high, but by using porous electrodes of carbon activated with finely divided metal, Davtyan was able to limit it to about 0·4-0·5 V. The efficiency of this cell is 61%, based on the available free energy, but it is probable that this could not be maintained over long periods, since the highly-active electrodes are poisoned by impurities in the gases used.

Other Types

In view of the promising results published by Davtyan, the Electricity Supply Research Council initiated research on this type of cell, the work being done by the British Electricity Authority under the direction of Dr. J. S. Forrest. The experiments so far completed are not regarded as encouraging.

Research has also been carried out by Dr. A. M. Posner at King's College, London, under the direction of Professor Sir Eric Rideal, on a fuel cell involving Redox processes. Various cells have been tested and some interesting results have been obtained. A considerable amount of work has yet to be done, however, both on the mechanism involved in the regeneration of the catalyst and on the conditions necessary to obtain maximum activity of the carbon. The cell has not so far proved as efficient as was originally expected and at this stage its potential usefulness cannot be finally assessed.

In 1932, patents were taken out by Dr. H. Greger for a fuel cell which was reported to give very satisfactory results, using hydrogen, carbon monoxide, or methane and oxgygen. The electrolyte used was a complex mixture of carbonates and chlorides of sodium potassium and barium, which melted at 600° C. In 1938, it was reported that laboratory tests had been successful and that the large-scale development of this process was under contemplation. No further information regarding the system has since been released.

Though it is evident that much work remains to be done before fuel cells capable of competing with established processes for the generation of electrical energy can become an actuality, recent developments suggest that the problems which remain are not incapable of solution. If the high efficiencies which have been achieved in laboratory tests can be produced on an industrial scale and maintained over long periods, then the fuel cell should find important applications. Although the energy is produced as low voltage direct current, which is not convenient for the transmission of large quantities of power, it is suitable for use in electrochemical processes, such as the electrolytic extraction of metals like aluminium and magnesium.

The possibility is foreseen that the first application for the Gorin cell might be in a growing electrochemical industry, possibly in conjunction with such projects as the underground gasification of coal. The main use proposed for the Bacon cell is in the storage of electrical energy. With efficient electrolysers this type of cell might be applied to traction, storage of wind power, or even storage of the electricity generated by power stations during off-peaks periods. Power could be stored in the form of gases, and it is probable that a battery of hydrogen-oxygen cells would weigh much less than the existing types of lead-acid accumulators of equivalent storage capacity.

High-Tensile Weldable Steel

METALLURGISTS have for many years been investigating the possibility of developing a steel which has high strength and at the same time can be readily welded. These properties are of particular importance for high pressure steam pipes. Among the workers in this field is the United Steel Companies Ltd., who, being manufacturers of steels covering a wide range of applications, regarded the development of this type of steel as of major importance. Many experimental steels have been produced and examined, but it was found that the more commonly used alloying materials resulted in the production of steels which were difficult to weld when satisfactory mechanical properties were attained.

In the process of work on low carbon content, molybdenum steels, Mr. W. E. Bardgett, research manager of the company, discovered that the addition of small quantities of boron had the property, when used in a certain ratio with the molybdenum, of doubling the yield point of low carbon steels without the necessity for heat treatment. As little as an ounce of boron, added to a ton of steel containing 0·40% of molybdenum, was sufficient to produce this pronounced and important improvement in strength.

The new steel has been given the name of "Fortiweld", a title derived from the properties of the steel, namely a tensile strength of 40 tons/sq in., combined with ease of welding—the latter property being attributable to the low carbon content.

In addition to its high strength at ordinary temperatures. "Fortiweld" possesses good properties at 450/500° F, being capable of withstanding service stresses two to three times the value of those permissible for mild steel.

The unique properties provided by this alloy, make it particularly attractive for highly stressed welded structures either at ordinary or elevated temperatures and many important applications are already in hand, including the casings of aircraft jet engines, special tubing and bridge components.

EXPANDED WATER TUBE JOINTS

A Survey of Modern Practice in Fitting and Maintenance

By SYDNEY D. SCORER, A.M.I.Mech.E.

THE satisfactory operation of a water-tube boiler depends a great deal upon the connections between the tube ends and their respective drums or headers.

In British practice the method of expanding the tubes into holes designed to receive them is used for all but the highest pressures and temperatures. The process is comparable to the production of a shrink-fit between tube and drum, but, unless performed competently, may result in much subsequent operating trouble. In addition to the hoop stress produced by expanding, the joint must resist a longitudinal pressure load tending to draw the tube out of its seating, and in some designs each joint must carry its share of the dead load represented by the weight of the lower drums. At all times the joint must remain pressure-tight.

Bell-mouthing of Tube Ends

Until about 40 years ago the now common practice of bell-mouthing the expanded ends was not generally applied, and many accidents resulting from the drawing-out of tube ends were attributed to lack of that precaution. Present-day British regulations specify that the tube end must project at least $\frac{1}{4}$ in. through the bearing area of the tube hole and that the amount of bell-mouthing (i.e. increase in diameter due to flaring) must be 1/16 in. plus 1/32 in. for each inch of tube external diameter. American rules ask for a projection of $\frac{1}{4}$ in. to $\frac{1}{2}$ in. before bell-mouthing, and the amount of bell-mouthing must be not less than $\frac{1}{4}$ in.

In boilers intended for moderate pressures the tube seat—the thickness of plate into which the tube is expanded—must be not less than $\frac{3}{4}$ in. That is for tubes which enter the plate in a radial direction. When the tubes do not enter radially, the plate must be recessed on the water side and then the seat must be not less than $\frac{1}{2}$ in.

Higher steam pressures have necessitated the use of thicker drums and tubes, and these have caused reconsideration of the expanding technique.

Expanding of Tube Ends

For relatively thin plates and tubes the ends are expanded manually. Only a skilled operator can do this work properly, and he usually judges its quality by the appearance of the mill scale about the hole. Once the scale begins to crack he stops expanding, and subsequent experiments have proved the soundness of this criterion. With thicker plates and tubes recourse was had to power-driven expanding tools, which, while still requiring skill in their manipulation, tended to divorce the operator from the "feel" of the expanding process. This made it necessary to devise a method of estimating the progress of the expanding.

Some manufacturers adopted special expanding sequences to ensure even deformation of the tube ends; others employed "go" and "no-go" gauges to indicate completion of expanding; and so on. One useful method is that which measures the longitudinal extrusion of the tube end outside the drum during the expanding process.

Measuring Amount of Expansion

In this a clock gauge, reading to a half-thousandth of an inch, is clamped to the tube outside the drum and just beyond the part to be expanded. The micrometer rod of the gauge presses gently against the cleaned surface of the drum exterior, and, when the tube end has been nipped in place, the gauge reading is noted. The amount of longitudinal extrusion required for a given tube size and pressure conditions is known from previous experiments, and expanding is continued until the tabulated figure has been reached. The amount may vary from 0·015 in. for a small tube intended to work at moderate pressure, to as much as 0·05 in. for larger tubes and higher pressures.

This method is said to give reasonably good results in practice, and its originators used it to demonstrate that expanding beyond the suggested limits only caused leakage under pressure. That effect is, of course, common knowledge to experienced boiler operators,

but it was confirmed and re-examined by other experimenters. They found that the pressure between tube and seat rose rapidly to a maximum value and thereafter fell to a nearly constant limiting value. It was considered that once slipping of the tube in its seat took place the seat pressure was markedly reduced. Seat grooves, therefore, are advantageous in preventing too easy extrusion of the tube. One set of experiments suggested that if the holding power of a plain seat is 100, that of a seat with one groove is 139 and with two grooves, 153.

Effect of Expanding on Tube Ends

While experiments of this sort have been useful in helping designers and boiler manufacturers to progress into regions of higher steam pressures and temperatures without too many "teething" troubles, the fact remains that in any expanded joint the expanded metal is no longer quite the same in a metallurgical sense as the metal of the rest of the tube. The expanded region is inevitably work-hardened to a certain extent, and it also appears that its electrical conductivity is lowered. It has been proved that drawn wires are anodic to annealed wires of similar metal, and it is therefore probable that much tube-end corrosion derives from that fact. When the expanded portion of a tube is badly corroded, no previous amount of skilled expanding will stop it from leaking or, in a serious example, from drawing out of its seat.

Susceptibility to Corrosion

According to the electrochemical theory of corrosion, when a potential difference exists between two metallic areas immersed in boiler water a minute electrical current flows between them. Hydrogen ions from the water then flow towards the cathodic area, and metallic ions are released (i.e. the metal is dissolved) at the anodic area. In boiler water that is not strongly alkaline the ferrous products remain in solution and the process continues, although it may be spasmodic if conditions allow the hydrogen to accumulate at the cathodic area and polarise it.

In properly treated boiler waters, however, the pH value is kept above the necessary figure of 9·4 at which the corrosion product is insoluble. The product tends to precipitate on to the anodic area and diminish the potential difference between the two areas. But when oxygen is present in the water it is very difficult to stop or even decrease the rate of progress of corrosion.

In these circumstances any hydrogen resulting from electrochemical action is immediately removed by combination with the oxygen. The hydrogen then has no opportunity of collecting over the cathodic areas to polarise them. As the anodic area of the tube end is small relative to the rest of the cathodic tube surface the attack is local and severe. It usually starts as pittings about the flared portion of the tube end, and if the pittings assume the confluent form small areas of metal may become detached.

The attack may be accentuated during or after a shut-down. If sludge or water is allowed to accumulate about the top ends of vertical tubes, a form of differential aeration is set up by currents passing between the large cathodic area exposed to atmospheric oxygen and the small anodic areas of the tube ends. Furthermore, when re-filling the boiler after a stoppage, air may be trapped between the drums and the bottom projecting ends of the tubes, thus providing excellent conditions for oxygen attack. A remedy is to bead over a few of the tube ends so that they are flush with the drum surface and act as vents.

Oxygen Removal

These effects are known to experienced boiler operators and every effort is made to remove oxygen by de-aeration and, if necessary, the addition of sodium sulphite to the boiler water. A pH value of 10·5 to 13 is maintained in the boiler water to assist the formation of a stable protective film over the internal surfaces, and every precaution is taken to eliminate dampness during standing periods.

Finally, it should be mentioned that if the other conditions, such as stress, etc., are favourable, it is possible for intercrystalline cracking (caustic cracking) to develop in expanded joints. There are records of this happening in American practice, and it is thought to have originated in slight leakages between the tube and tube seat which allowed the necessary concentration of sodium hydroxide in the minute annular space. Usually the parts have been under high stress and the resulting crack (often circumferential) has been a typical intergranular type.

It is hoped that these few notes on this important subject may be of use to those who have to deal with the operation and maintenance of water tube boilers. Other articles on this, dealing with corrosion, appeared in the ELECTRICAL TIMES on February 19 and June 18, 1953.

NOTES ON WIRING by Megohm

Electricity on Building Sites

THE provision of proper services to building sites is most important, since where there is an adequate and well distributed supply of electrical energy on such sites labour savings can be made by the use of power-driven equipment resulting in a general speed-up of construction work. The advisability of having proper electrical services on building sites has recently been drawn to the attention of Housing Authorities, County Councils and the like in a circular letter issued by the Ministry of Housing and Local Government. This stresses that there is much advantage to be gained by having electricity available on sites before building operations commence. When supply is made available at a reasonable tariff there is every likelihood that building contractors and their sub-contractors will make increasing use of power-operated tools and further temporary lighting will be more extensively used so that normal working hours need not be reduced during the winter months.

Permanent Supply

The electricity boards should bring in a permanent supply and not temporary services which may have to be removed at some future date to make way for the permanent installation. It is, therefore, desirable and necessary to plan ahead and get locations fixed for the sub-station or terminal points and whatever building work is required for the electrical services. This should be put in hand immediately so that the permanent switch, distribution and metering equipment can be permanently installed.

From the board's terminal points a convenient method for distributing electrical energy to various working locations on the site will be required. It is here that the electrical contractor's experience will be valuable in providing a safe, flexible and inexpensive system of distribution. Some civil engineering and building contractors, of course, have their own electrical department which deals with local distribution installations and maintenance of site temporary lighting and power services.

A method of distribution which should prove satisfactory and economic for building contractors' temporary electrical services is the erection of a ring main on poles around the building site using, for example, the 'Grid Suspension' outdoor wiring system with connecting fuse boxes fitted to each or alternative poles. Such a system using pre-formed lengths of cable may be readily erected, dismantled and re-erected in other locations thus saving materials and time.

From the fuse boxes, connection may be made to 415/110 V 50 cycles a.c. double wound step down transformers, the secondary winding of the step down transformers, of course, being earthed at mid-point, to ensure the maximum potential between the "live" conductor and earth does not exceed 55 V. From the fused secondary terminals of the transformers which may be pole mounted, pre-formed lengths of grid suspension cable complete with multiple gang fused plug socket-outlets housed in robust cases, can then be strung to any convenient point where work is in progress so that the work people can conveniently plug in their power-driven tools and, of course, temporary lighting points and hand lamps may also be plugged in to these multiple gang fused plug socket-outlet connection boxes. By using pre-formed lengths of cable and socket-outlet units, these may be quickly moved around sites to meet the requirements of the constructional programme and should reduce the amount of temporary wiring one sees slung through buildings in the finishing stages of jobs.

A New Approach

A new approach to temporary installation work on building sites is overdue, and whilst it is not suggested that the method described is new, or for that matter novel, since it has been in use in the United States for some time on large constructional jobs, it is, however, considered that if a serious attempt on these lines is made by our civil engineering and building contractors, it will show good returns, firstly in providing better general working conditions and secondly, as a consequence, an increase in output per man-hour. If during the first year a small increase in output is achieved, my wish would be that all should benefit in the prosperity that is waiting to be grasped by greater mechanisation in building work in 1954.

The Three-Circuit Transformer

The Problem of Load-Sharing Between Units in Parallel

By A. SALZMANN, Dipl. Eng., A.M.I.E.E.

IN a previous article published in the ELECTRICAL TIMES (July 30, 1953) the author has pointed out that a number of network problems can be solved by application of three-circuit transformers in transmission systems operating at different voltages.

In this short analysis it is proposed to deal with load-sharing problems. Here again, the equivalent impedances z_1, z_2, z_3 of the primary "P," secondary "S," and tertiary "T" windings can be represented as a star circuit (Fig. 1) and determined by aid of the following formulae.[1]

$$\left.\begin{aligned} z_1 &= \tfrac{1}{2}\left(\frac{P_a}{P_1}z_{12} + \frac{P_a}{P_1}z_{13} - \frac{P_a}{P_2}\frac{P_1}{P_2}z_{23}\right) \\ z_2 &= \tfrac{1}{2}\left(\frac{P_a}{P_1}z_{12} + \frac{P_a}{P_1}\frac{P_1}{P_2}z_{23} - \frac{P_a}{P_1}z_{13}\right) \\ z_3 &= \tfrac{1}{2}\left(\frac{P_a}{P_1}z_{13} + \frac{P_a}{P_1}\frac{P_1}{P_2}z_{23} - \frac{P_a}{P_1}z_{12}\right) \end{aligned}\right\} \ldots (1)$$

In these equations P_1, P_2 and P_3 represent the MVA ratings of the primary, secondary and tertiary windings; P_a = an arbitrarily selected MVA base; z_{12} = percent leakage impedance between P and S windings (see Fig 2) expressed in percent on MVA base of the primary winding; z_{13} = percent leakage impedance between "P" and "T" windings expressed in percent on MVA base of the P winding; $(P_1/P_1)z_{23}$ = percent leakage impedance between "S" and "T" windings expressed in percent on MVA of the primary winding; $(P_a/P_1)z_{12}$ = percent impedance between "P" and "S" windings expressed in percent on an arbitrary base, P_a MVA; $(P_a/P_3)\ z_{13}$ = percent impedance between "P" and "T" windings on P_a MVA base, and $\frac{P_a}{P_1}\frac{P_1}{P_2}z_{23}$ = percent impedance between "S" and "T" windings expressed in percent on MVA base P_a.

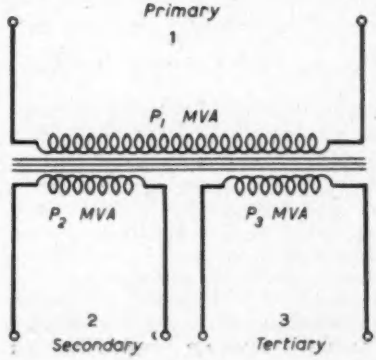
This equivalent circuit (assuming the excitation has been neglected) will prove a very useful tool in solving load problems.

Load-sharing Problem

When the loads on both secondary "S" and tertiary "T" busbars are increased, the introduction of a further three-winding unit will be required to meet the increased demand. In paralleling these units, no difficulties will arise, provided the conditions for load sharing are satisfied. These are:

(*1*) Same voltage rating. (*2*) Same no-load ratio of transformation. (*3*) Zero phase displacement between vectors representing primary, secondary and tertiary voltages. (*4*) Same percentage impedances. (*5*) Same ratio of resistance to reactance for z_1, z_2 and z_3; and (*6*) Similar ratings of the primary, secondary and tertiary windings.

In practice these ideal conditions for paralleling are not always present, and one must be satisfied that no unit is subjected to overload



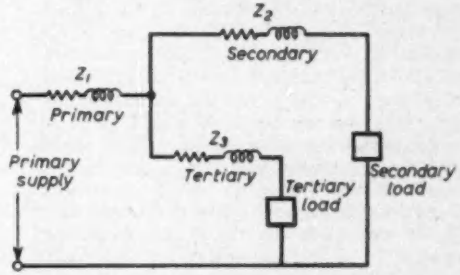


Fig. 1 (left) is a schematic diagram of a 3-winding transformer. Fig. 2 (above) is the equivalent network of the star-connected circuit

in case the load is not shared in proportion to the MVA ratings of the windings.

To understand the load-sharing problem between three-circuit transformers, let us consider briefly two winding units. It is well known if two-winding transformers having dissimilar MVA ratings P_1 and P_2, and impedances z_1 and z_2 respectively, are paralleled, and if $P_1 < P_2$ and $z_1 < z_2$, the unit with smaller output, P_1 MVA becomes overloaded, while

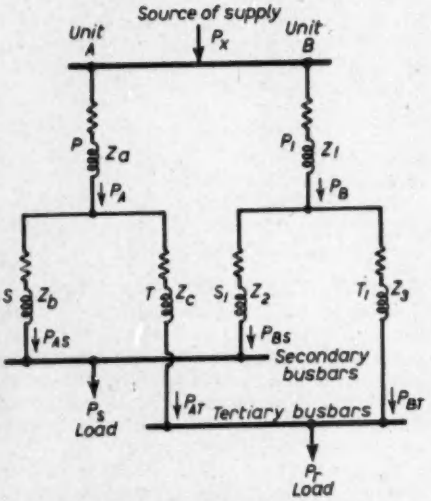


Fig. 3. Schematic diagram to illustrate load sharing between two 3-circuit transformers

the unit with larger output, P_2 MVA, is underloaded. This follows from

$$P_1^1 = P \angle\Phi^\circ \frac{z_2 \angle\theta_2^\circ}{z_{12} \angle\theta_{12}^\circ} \quad \ldots\ldots\ldots(2)$$

$$\text{and } P_2^1 = P \angle\Phi^\circ \frac{z_1 \angle\theta_1^\circ}{z_{12} \angle\theta_{12}^\circ} \quad \ldots\ldots\ldots(3)$$

when applying Kirchoff's law to the circuit. In these equations $P=(P_1^1+P_2^1)$ MVA represents the total demand on the l.v. busbars, and $P_1^1 \angle\Phi_1{}^\circ$ and $P_2^1 \angle\Phi_2{}^\circ$ loads carried by each unit, z_1 and z_2 are the impedances expressed in percent on an arbitrarily selected MVA base, θ_1° and θ_2° the impedance angles and z_{12} the vectorial sum of z_1 and z_2.

In the case where the smaller unit with lower impedance is subjected to loads exceeding the safe value, the transformer with larger output, P_2, should be re-rated by reducing its MVA output until the impedance drop is equal to that of the smaller unit at rated value. Substituting in equation (2) for P_1^1 the rated value P_1 MVA, we obtain

$$P_x = P_1 \angle\Phi_1{}^\circ \frac{z_{12} \angle\theta_{12}^\circ}{z_2 \angle\theta^\circ{}_2} \text{ MVA}$$

the maximum load available on the l.v. busbars. The re-rated MVA (P_2'') of the unit with larger output is determined by substituting for P in equation (3) the value P_x MVA, hence the total load which can be carried by both units without exceeding the safe load of the smaller unit is equal to (P_1+P_2'') MVA.

However, it should be emphasised that the safe loading value may exceed the transformer rating value for a certain time, depending on (*a*) the type of load to which the unit is subjected; (*b*) ambient temperature; and (*c*) transformer temperature at which overload starts.

Load Sharing Between Three-circuit Transformers

Let us consider two units A and B with similar MVA ratings and impedances shown in Fig. 3. To simplify the problem, the loads on the "S" and "T" busbars are assumed to have the same power factors, the ratio of resistance to reactance of each branch of the equivalent circuit is equal and the impedances shown are expressed in percent on an arbitrary MVA base. For convenience the MVA rating of the primary winding of the larger unit A is selected.

The load P_S on the "S" busbars is shared by units A and B according to equations (2) and (3). Then

$$P_{AS} = P_S \frac{z_1+z_2}{z_1+z_2+z_a+z_b} = P_S \times A \ldots(4)$$

$$P_{BS} = P_S \frac{z_a+z_b}{z_a+z_b+z_1+z_2} = P_S \times B \ldots(5)$$

Similarly the load P_T on the "T" busbars is shared and

$$P_{AT} = P_T \frac{z_1+z_3}{z_a+z_b+z_1+z_3} = P_T \times C \ldots(6)$$

$$P_{BT} = P_T \frac{z_a+z_c}{z_a+z_c+z_1+z_3} = P_T \times D \ldots(7)$$

The primary winding of unit A carries the load

$$P_A = (P_{AS}+P_{AT}) = P_S(1-B)+P_T(1-D) \ldots(8)$$

and unit B the load

$$P_B = (P_{BS}+P_{BT}) = P_S B + P_T D \ldots\ldots(9)$$

From these equations it follows that for identical ratings of the "P," "S," "T," "P_1," "S_1" and "T_1" windings and their identical equivalent impedances $z_a=z_1$; $z_b=z_3$; $z_c=z_3$ we obtain $A=B=C=D=\frac{1}{2}$; $P_{AS}=P_{BS}=\frac{1}{2}P_S$; $P_{AT}=P_{BT}=\frac{1}{2}P_T$; $P_A=\frac{1}{2}(P_S+P_T)$; $P_B=\frac{1}{2}(P_S+P_T)$ and both units will share the load equally. For identical percentage impedances but

similar winding ratings in relation to each other, say $P=X$ MVA; $S=X$ MVA; $T=\frac{1}{2}X$ MVA; $P_1=\frac{1}{2}X$ MVA; $S_1=\frac{1}{2}X$ MVA; $T_1=\frac{1}{2}X$ MVA, and assuming X MVA base we obtain $z_1=2z_a$; $z_2=2z_b$; $z_3=2z_c$; $A=C=2/3$; $B=D=1/3$; $P_{AS}=2/3P_S$; $P_{BS}=1/3P_S$; $P_{AT}=2/3P_T$; $P_{BT}=1/3P_T$; $P_A=2/3(P_S+P_T)$; $P_B=1/3(P_S+P_T)$; consequently the transformers will share the loads in proportion to the MVA ratings of the windings.

In a similar manner the transformer loading can be determined if there is a difference in the power factors of the secondary and tertiary loads, or if the ratio of resistance to reactance of the impedances is not equal.

TABLE I

Units	Ratings MVA			% Equivalent Impedance Ref. 10 MVA Base*		
	P	S	T	P	S	T
A	10	10	5	7	3	13
B	10	5	5	8	8	6

* *Ratio of resistance to reactance constant.*

However, in the case when transformers with dissimilar ratings and impedances are involved, some windings are likely to carry loads exceeding the rated value. For instance, load-sharing between unit A and B whose constants are given in Table I, assuming $P_S=P_T=10$ MVA and identical pf's is as follows:

$A=0{\cdot}384$; $B=0{\cdot}616$; $C=0{\cdot}588$; $D=0{\cdot}412$; $P_{AS}=3{\cdot}84$ MVA; $P_{BS}=6{\cdot}16$ MVA; $P_{BT}=4{\cdot}12$ MVA; $P_{AT}=5{\cdot}88$ MVA; $P_A=P_B=10$ MVA. It is apparent the secondary winding of unit B becomes overloaded (23%) the same applies to the tertiary winding of unit A (17·6%).

Summing up, in paralleling three-circuit transformers two different load voltages are involved and no operation difficulties will arise provided the conditions for parallel operation are satisfied. In case ideal conditions do not exist load division should be calculated for prospective loads in order to forecast the safe loading for each unit.

Load-sharing between Three-circuit and Two-circuit Transformers

Parallel operation between an existing three-circuit unit and a two-winding transformer is more complex than it is realised. Since the tertiary load is independent of the secondary load, a change in the former will alter the distribution of the load between the two-winding unit B and the secondary winding of unit A as shown in Fig. 4. The flow of the tertiary load in the primary winding produces a voltage drop which, in turn, will disturb load-sharing, particularly if the impedance z_1 is large.

To simplify the problem, we assume loads on the "S" and "T" busbars to be P_S MVA and P_T MVA at the same p.f. The secondary load P_S is shared by A and B according to equations 2 and 3.

$$P_{AS}=P_S\frac{z}{z_1+z_2+z} \quad \ldots\ldots\ldots\ldots\ldots\ldots (10)$$

$$P_{BS}=P_S\frac{z_1+z_2}{z_1+z_2+z} \quad \ldots\ldots\ldots\ldots\ldots\ldots (11)$$

Similarly the tertiary load is shared by A and B.

$$P_{AT}=P_T\frac{z+z_2}{z_1+z_2+z} \quad \ldots\ldots\ldots\ldots\ldots\ldots (12)$$

$$P_{BT}=P_T\frac{z_1}{z_1+z_2+z} \quad \ldots\ldots\ldots\ldots\ldots\ldots (13)$$

Take the case where only the secondary load is increased and the tertiary load remains constant and equal to P MVA. Apparently it will be justifiable to utilise a two-winding unit, say, B to share the load with the three-circuit transformer. Assuming the name-plate rating

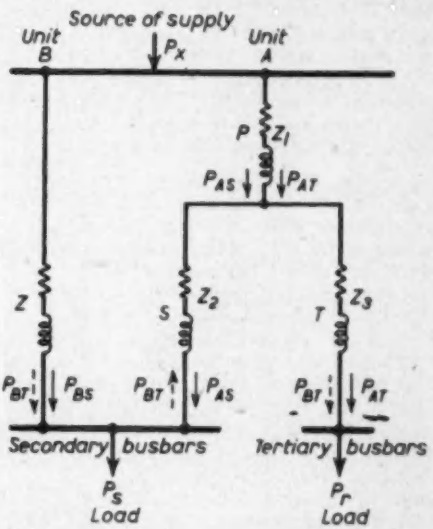


Fig. 4. Load-sharing between two-winding and three-winding transformers (equivalent circuit)

of unit B to be P MVA, the load P_{BT} delivered by unit B to the "T" busbars is determined from equation (13), thus leaving $P_{BS}=(P-P_{BT})$ MVA available on the "S" busbars. Substituting in equation (11) for P_{BS} the value $(P-P_{BT})$ we obtain the maximum load which can be supplied to the "S" busbar.

$$P_S=(P-P_{BT})\frac{z_1+z_2+z}{z_1+z_2} \quad \ldots\ldots\ldots(14)$$

It follows that the available load on busbars "S" will depend on the magnitude of the tertiary load, rating and impedance of unit B.

As an illustration, let us consider the circuit Fig. 4, whose characteristics are given in Table II. It is assumed that the ratio of resistance to reactance of the impedances is constant. The errors involved in this simplification are negligible. The pf's of the secondary and tertiary loads are identical. The load on

TABLE II

Transformer	Winding	Rating MVA	Impedance based on 5 MVA	Equivalent Impedances*
A	Primary	5·0	P/S $Z_{12}=10\%$	$Z_1=6\%$
	Secondary	2·5	P/T $Z_{13}=10\%$	$Z_2=4\%$
	Tertiary	2·5	S/T $Z_{23}=8\%$	$Z_3=4\%$
B	Primary/ Secondary	2·5	$Z=8\%$	

* *Evaluated with formula* 1.

the "T" busbars $P_T=2{\cdot}5$ MVA remains constant subsequent to the connection of the two-winding unit B.

The load available on busbars "S" is obtained by substituting the corresponding values given in Table II in equations (13) and (14) and is equal to

$$P_S=(2{\cdot}5-0{\cdot}83)\frac{18}{10}=3 \text{ MVA.}$$

A surprising result, since an increase of the transformer ratings from 2·5 to 5·0 MVA (100%) permits only 20% load increase on the secondary busbars.

Unit B carries $P_{BS}+P_{BT}=1{\cdot}67+0{\cdot}83=2{\cdot}5$ MVA, secondary winding of unit A $(P_{AS}-P_{BT})=1{\cdot}33-0{\cdot}83=0{\cdot}5$ MVA and the tertiary $P_{AT}+P_{BT}=2{\cdot}5$ MVA. In similar manner we can determine the loading of each unit if the load on the tertiary busbars is diminished to zero.

From inspection of the load curves shown in Fig. 5 (dotted lines) it is apparent that the three-circuit unit is underloaded. With zero tertiary load the maximum available load on the "S" busbars is equal to $P_S=4{\cdot}5$ MVA.

In order to utilise the transformer ratings to the full extent it will be therefore required to select a two-winding transformer with larger impedance and its magnitude can be derived as follows.

If unit B is rated at $P=P_{BS}+P_{BT}=2{\cdot}5$ MVA is to divide the maximum load $P_S=5{\cdot}0$ MVA on the "S" busbars equally with the three-circuit transformers, the apparent correct value of the impedance z is determined from equations (11) and (13)

$$2{\cdot}5=5\frac{10}{10+z}+2{\cdot}5\frac{6}{10+z}$$

from which we obtain $z=16\%$ on a 5 MVA base and 8% at the rated value 2·5 MVA.

Applying, then, equations (10) to (13) the load-sharing is as follows: Unit B carries $P_{BS}+P_{BT}=1{\cdot}925+0{\cdot}575=2{\cdot}5$ MVA. Secondary winding of unit A, $(P_{AS}-P_{BT})=3{\cdot}075-0{\cdot}575=2{\cdot}5$ MVA and tertiary winding $(P_{AT}+P_{BT})=1{\cdot}925+0{\cdot}575=2{\cdot}5$ MVA. However, if the tertiary load is removed the "S" winding of unit A carries $P_{AS}=3{\cdot}08$ MVA and the two-winding unit $P_{BS}=1{\cdot}92$ MVA (equation 11) consequently the former becomes overloaded. The load on the "S" busbars should be reduced according to equation 10 to $P_S=4{\cdot}06$ MVA. (Substituting for $P_{AS}=2{\cdot}5$ MVA) if the tertiary winding remains idle. Transformer B will carry 1·56 MVA, unit A will carry 2·5 MVA and satisfactory load-sharing between

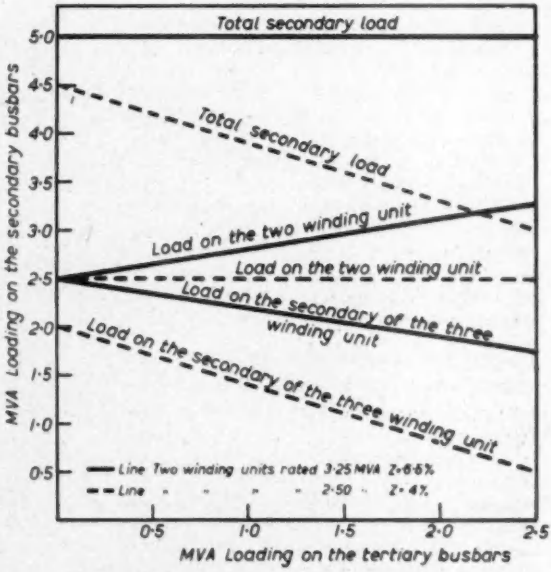


Fig. 5. Loading curves for varying tertiary loads

A and B (the latter having an impedance $z=8\%$) is secured only if the tertiary load remains constant.

It is apparent if both units should deliver to the "S" busbars the total demand equal to 5·0 MVA regardless of the load on the tertiary winding and no unit should be subjected to loads exceeding the safe value, both the MVA rating and impedance of unit B should be altered.

With an idle tertiary winding ($P_T=O$) and the requirement $P_{AS}=P_{BS}$ MVA the impedance of unit B based on 5 MVA must be equal to $z=z_1+z_2=6+4=10\%$. This follows when comparing equations 10 and 11. Both units will share the load on busbars "S" equally if the two-winding transformer is designed to have 5% impedance based on the rating 2·5 MVA.

However, if the "S" and "T" busbars are fully loaded $P_S=5$ MVA and $P_T=2{\cdot}5$ MVA unit B will carry according to equations 10 to 13. $P_{ES}+P_{BT}=2{\cdot}5+0{\cdot}75=3{\cdot}25$ MVA "S" winding $P_{AS}-P_{BT}=2{\cdot}5-0{\cdot}75=1{\cdot}75$ MVA and the tertiary $P_{AT}+P_{ET}=1{\cdot}75+0{\cdot}75=2{\cdot}5$ MVA. It is apparent the two-winding transformer should be designed with rating 3·25 MVA and $5\frac{3{\cdot}25}{2{\cdot}5}=6{\cdot}5\%$ impedance on a 3·25 MVA base in order to secure satisfactory load-sharing, regardless of the load of the tertiary winding. On a 5 MVA base the impedance is equal to $z=6{\cdot}5\frac{5}{3{\cdot}25}=10\%$.

From inspection of the load curves shown in Fig. 5 (full lines) it follows that the secondary busbar load remains constant regardless of the tertiary load and both units deliver the maximum required load to the "S" busbar.

For instance, for $P_T=1{\cdot}5$ MVA we obtain $P_{AS}=2{\cdot}5$ MVA; $P_{BS}=2{\cdot}5$ MVA; $P_{AT}=1{\cdot}05$ MVA; $P_{BT}=0{\cdot}45$ MVA; unit B carries $P_{BS}+P_{BT}=2{\cdot}95$ MVA; "S" winding $P_{AS}-P_{BT}=2{\cdot}05$ MVA; and both units deliver to the "S" busbars $P_{BS}+P_{BT}+P_{AS}-P_{BT}=5$ MVA.

In similar manner load division between both units can be determined if the load pf's on the "S" and "T" busbars are different.

Alternatively, there is another way to solve this load problem satisfactorily. From equation 1 it follows that if $(P_a/P_1)\,z_{12}=(P_a/P_1)\,z_{13}$ and

$$\frac{P_a}{P_1}\frac{P_1}{P_2}z_{23}=2\frac{P_a}{P_1}z_{12}=2\frac{P_a}{P_1}z_{13}$$

the equivalent impedance z_1 becomes zero. Thus the flow of tertiary load in the primary winding produces no voltage drop (because of $z_1=0$) in this winding and consequently will not disturb the load-sharing. Unit A and B will share the secondary load in proportion to the MVA rating of the windings, regardless of the magnitude of the tertiary load.

Practically this can be achieved by proper arrangement of the primary, secondary and tertiary windings on each limb of the core namely by placing the primary winding between the tertiary and secondary winding, making the tertiary the inner and the secondary the outer winding.[2]

However, although it is desirable from standpoint of load-sharing and voltage regulation to have a lower impedance or, in some cases, a higher impedance, it is likely to be a more practical solution because of lower short-circuit values and consequently lower cost of switchgear.

Conclusion

Summing-up, load-sharing between two or several three-circuit transformers, two-winding and three-winding units is more complex than it is realised. Generally, satisfactory operation is secured if no transformer is subjected to loads exceeding the safe value of transformer rating.

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2. Bruce, R.: "Some Notes on the Application of Three-winding Transformers." Heaton Works Journal, Summer, 1950, p. 391.

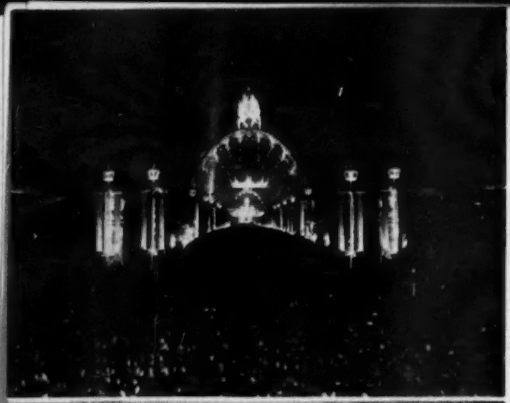
BRITISH STANDARDS

Packaging Code: Mechanical Aids in Package Handling. *B.S.*1133: *Section* 4: 1953. *Price* 6*s. net*. Correct handling of packages in transit is necessarily a part of any packaging code, and, as the foreword to this standard points out, there is a great deal which can be done to improve handling of both packaging materials and filled containers during movement in the factory. Manual handling at its best is expensive in time and labour, whereas an efficient mechanical handling system results in greater safety to both operator and goods. This standard is, in effect, a comprehensive collation of mechanical package handling equipment, giving notes to assist users in the selection and proper use.

Direct Current Ratiometer Indicators for Aircraft. *B.S.*2G114: *November*, 1953. *Price* 2*s*. Included in this revision are data relating to platinum resistance thermometer elements adding to that already given on nickel resistance elements. An appendix provides information on minimum tests recommended to verify serviceability of instruments manufactured in compliance with this standard's requirements.

DIARY OF

CORONATION YEAR



THE year 1953 was predominantly memorable for the Coronation ceremonies. For the first time, through the medium of electricity, the man in the street was privileged to be present at the Abbey service, and to obtain indeed, a closer and more intimate view of the proceedings than many of the notabilities who were actually present.

In the electrical field, steady progress was made in overcoming the plant shortage, and a notable event was the commissioning of the first section of the 275 kV grid system. The B.E.A., however, continued to complain of the restrictions on capital expenditure as laid down by the Treasury. Signs also became evident of a determination on the part of the electrical industry to fight back even more actively against the heavy anti-electric propaganda based on fuel conservation considerations, which had developed in the previous year.

Government Activities

A welcome relaxation at the beginning of the year was the lifting of controls on the manufacture and supply of electrical equipment. Further aid to the small firm engaged in export orders was, in the latter part of January, promised by Mr. Sandys, who hinted at the possibility of assistance in the form of credit terms.

An important step was taken towards the end of March when the Heating Appliances (Fireguards) Act 1952 became operative, and in April, the hard work done by all branches of the industry to bring home to the Government the vital necessity of purchase tax reduction bore fruit in Mr. Butler's Budget, where considerable alleviation was provided.

Later in the month the mounting road accident figures led to the probability that the Treasury would look with more favour on proposals to improve street lighting in the fol-

Coronation resulted in this classic picture of the Mall (top). Littlebrook in the floods is shown under, and one of the earlier views of Bankside "B" follows. Last is the erection of the Enfield wind driven generator

THE YEAR

ACTIVITIES REVIEWED

lowing winter. It was only a short while after that the winter situation was further clarified by the announcement that no national load-spreading target would be set for the winter 1952/53.

By the end of July, the thoughts of the public began to turn towards the following winter, and the question of "smog" began to become prominent. To investigate the problem the Beaver Committee was appointed, and in our editorial of July 30th, we welcomed the establishment of this committee as being a means of killing the long perpetuated fallacy of power station emission as a major contributor to the situation. It was interesting to note that when in December, the Beaver Committee issued its interim report, power stations were completely vindicated.

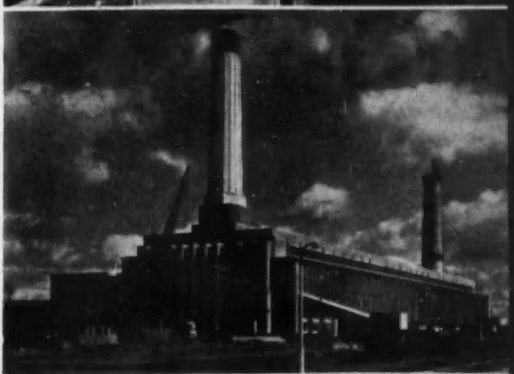
Another important relaxation of control in the year was the gradual advance towards private trading in metals, and copper, the most important metal in the electrical industry, was finally freed in early August.

The hint given earlier in the year that street lighting might be improved was fulfilled by the announcement in August, that an additional £500,000 could be spent on street lighting schemes.

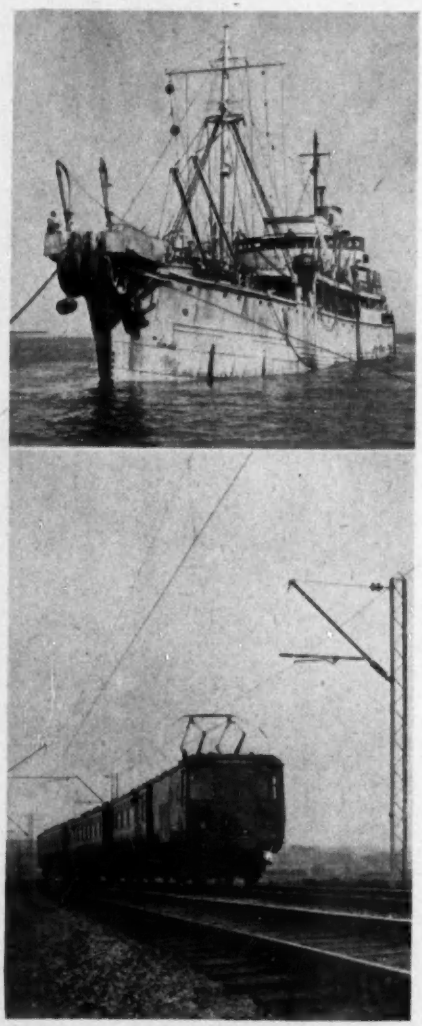
Relaxations in the restrictions of imports from Western Europe were promised by Mr. Butler in October and in November the whole range of electrical appliances were put on open general licence.

Power and Distribution

One of the earliest power station features of the year was our description of the first half of Bankside "B" power station, about which so much controversy raged in its earlier stages. At the beginning of February, the serious Thames floods took place resulting in widespread damage to houses and property



Reading from top to bottom is first Sir John Hacking receiving the first presidential badge at the B.E.P.C.: Miss Caroline Haslett. Sir Henry Self and Mr. V. Dale at the opening of E.D.A.'s test house: A view of Uskmouth, and Sir John unveiling a plaque at Staythorpe 275 kV grid substation is right



The laying of test length of the 132 kV England-France cable is followed (under) by the first experimental 50 c/s rail electrification in Great Britain

along the lower reaches of the river. The electricity supply system did not emerge unscathed, Littlebrook "A" and "B" stations having their basements flooded, and Deptford being temporarily affected. Several of the Eastern Division's stations were also involved. A severe setback to the B.E.A.'s programme of building occurred in early May when after some 2½ years' struggle, the Authority was refused consent to the building of a new power station at Machen (Mon.) on the grounds that it would be detrimental to rural amenities.

For some time, discussions had been going on between the British Electricity Authority and Electricité de France on the possibility of a cable link between the two supply systems, and towards the end of June it was announced that a programme had been arranged to carry out preliminary tests of cable lengths in undersea conditions. At about the same time, the Enfield wind-power project advanced further when the 100 kW unit, being designed for the B.E.A. was in process of erection at Prae Wood near St. Albans.

Probably the most notable electrical event was the excitation, by Sir John Hacking, of the first stage of the 275 kV grid system from Staythorpe to West Melton at its full working voltage. Although this section was not truly representative of the Supergrid as a whole, it will yet provide most valuable technical data relating to these high transmission voltages.

The first practical testing in connection with the cross-Channel 132 kV link was carried out at Dover at the beginning of August, and results are being assessed. In the power station field, we published an exclusive account of Keadby at the end of the month.

In October the B.E.A. Annual Report appeared and showed that while financially the year 1952/53 had been successful, the sales increase had been disappointing as the rate of 3·7% was below the average rate expected.

Nuclear Power

The problem of the application of nuclear fission to the generation of power continued to exercise the physicists and electrical engineers of the country, and several pronouncements were made. In January, Sir John Cockroft, in a lecture to the I.E.E. estimated a possibility of producing atomic power at about 0·7d./unit, and stated that he was fairly certain that large-scale natural uranium-using power stations could be built on a time-scale similar to that for conventional stations.

On May 7, the announcement was made that work had begun on an atomic power station near the existing atomic establishment at Windscale, near Sellafield, Cumberland, thus marking the first step towards the commercial production of nuclear energy. Later in the year Sir John Hacking estimated that atomic energy would be available in 10 to 15 years' time.

The first big electrical function of the year was the highly successful A.S.E.E. exhibition

at Earls Court which opened its doors on March 25 with some 107 exhibitors as compared with 58 in the previous year, and with a period extended to four days instead of two. This was followed in April by the Physical Society's Exhibition, which still, to judge by the packed crowds, retains its attraction. Next in chronological order was the British Industries Fair which, although well supported at Birmingham, showed in London an increasing lack of appreciation.

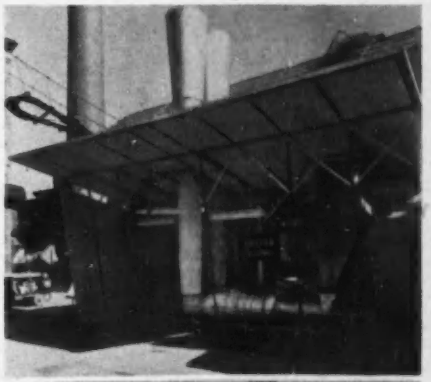
At the beginning of June, there opened that highlight of the electrical year, the B.E.P.C. Convention where the general atmosphere of the papers had an added sense of purpose and of faith in the future of electricity. The President, Sir John Hacking, again emphasised his confidence in the development of nuclear power, which he regarded as the only ultimate long term solution to the problem of the nation's dwindling power resources.

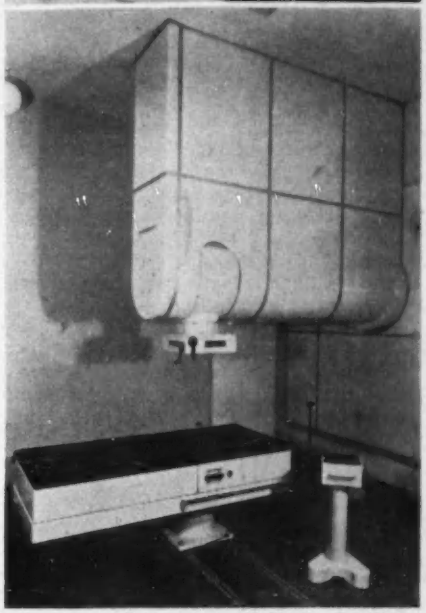
Engineering matters were again predominant, in a different manner, at the British Association's annual meeting which took place in September at Liverpool. Despite the gloomy prognostications about the British Association, it still continues to exert a powerful influence and its attraction appears in no way diminished. Also at Liverpool in September was held the Association of Public Lighting Engineers' annual conference and exhibition which was again most successful.

Purchase Tax

The campaign against purchase tax on electricity appliances continued unabated throughout the year, one of the more powerful speeches being that of Mr. W. T. Trace at the Annual Dinner of the E.C.A. who regarded the falling-off of electrical demand as an ominous sign and pleaded for an all-party attack on the problem. Purchase tax was again the principal topic at the British Association Luncheon in February, when Mr. E. Hartley Leather, M.P., came out wholeheartedly against the tax and disagreed firmly with the findings both of the Douglas and Hutton Committees.

All through the first part of the year, attention had been paid to the coming Coronation in which illuminations and floodlighting had such an important part to play, and by April many of the schemes were being erected and tested in preparation for the event, and on Coronation Day itself, these displays added much to the general rejoicing and festive atmosphere. A selection of some of these illuminations was published in our issues of June 4 and 11.





Power for the Engineering and Marine Exhibition (under strike conditions) was provided by Ruston and Hornsby's gas turbine. At Hammersmith (below) the 8 MeV Metrovick linear accelerator began its work

As the year wore on, the dispute between the E.T.U. and N.F.E.A. developed into what was termed by the Union, guerilla warfare. At the end of August strikes were organised at strategic places. By September 24 the situation had become so grave that a public enquiry was held into the problem, and peace, temporarily restored. We have not dealt with recent events as these will still be fresh in memory.

PROBLEMS AND PRACTICE in Engineering

Chattering in Sympathy

A RATHER baffling fault occurred on the electrical control circuit of a textile type hydro-extractor. These usually take the form of a revolving drum with a vertical shaft inside a totally enclosed case. The case of this particular machine was slung at three points, the aim being to absorb vibration due to any unbalance in loading. The driving motor was of the d.c. series type mounted vertically underneath the drum, to which its shaft was directly coupled.

It is necessary, with these machines, to provide the utmost safety by incorporating an electro-mechanical interlock on the lid and another on the manually operated brake. This took the form of a micro-switch directly operated by a cam on the brake lever. The starting was by remote push button and a three-step starter with lock-out coils.

The trouble reported was automatic cut-off some little time after the machine had been started under load, but immediate pressure on the start button would have the effect of enabling the run to be continued satisfactorily without further interruption. Since a run was normally automatically controlled over a period of about ten minutes, it was natural to first suspect the timer, but this was found to be functioning satisfactorily. The whole control circuit was also checked, with a negative result.

It was then noted that a run could always be completed if the machine was run on no load, and this conjured up the idea of vibration due to unbalanced loading being a cause of the trouble. The two electrical interlocks on the machine itself were cut out of circuit and the machine was then found to operate successfully. From further elimination it appeared that the culprit was the brake interlock micro-switch, but this was found, by all tests, to be making a reasonably good contact.

Further observation showed that this automatic cut-off, besides only occurring on load, always occurred when the third step of the starter operated. On pursuing this point it was discovered that the economy resistance in the main operating coil circuit only became connected in circuit when the third step operated. The causes of the trouble were then defined as follows. The machine ran satisfactorily until the economy resistance became inserted, when the voltage across the main coil was reduced considerably though not enough, normally, to release the main contactor. With an unbalanced load, however, the vibrations on the machine at a certain speed became in sympathy with the natural frequency of vibration of the spring contact on the micro-switch, so that, at this point, the contact was chattering.

This had the effect of inserting undesirable resistance into the coil circuit so that when further resistance was inserted, in the shape of the economy resistor, the voltage across the coil was so far reduced as to be no longer able to maintain the contactor. If the machine was enabled to pass to a higher speed, by manual maintenance of the contactor, the contactor again became able to maintain itself.

The voltage across the coil was measured through several runs and the fall at the critical stage was most marked. The values immediately commenced to rise again as the speed of the machine progressed after the economy resistance became inserted. The trouble was cured by arranging more spring pressure on the micro-switch.—*F. Butcher.*

Measuring Slip

ON occasions it has been necessary to determine the speed of induction motors, so situated that neither end of their shafts was accessible. Under these circumstances the pocket compass can be again usefully pressed into service, this time to determine the slip frequency of the rotor. The compass is placed near the end plate of motor, in the same horizontal plane as the shaft, where the fluctuating field will cause the needle to deflect in sympathy. After counting the number of deflections of the needle in a minute, the slip speed of the motor is given by this number divided by the number of pole pairs. The synchronous speed can be calculated by the normal method, and a simple subtraction gives the actual rotor speed.—*D.M.K.*

Contributions to this page dealing with specific items of interest to electrical engineers and maintenance men are welcome, and, if accepted, will be paid for at our standard rates. Problems of a practical nature to which a solution is required will also be considered. Contributions should be written on one side of the paper only and may be accompanied by sketches, which will be re-drawn for publication.

M.K.S. Mechanical Units

Conversion Procedures for Force and Energy

By J. E. MACFARLANE, B.Sc.(Eng.), M.I.E.E., A.M.I.Mech.E.

STUDENTS who have taken Physics at school are aware of different units for force and mass, in the absolute c.g.s. system, the dyne and the gramme respectively. It is also possible that they have been introduced to the poundal and pound. Thus the use of the Newton as the unit of force is not illogical when we require a convenient electrical system to supercede the c.g.s. electromagnetic and electrostatic units with their inconvenient conversion factors. Some mechanical engineers even use the "slug," which may be termed a reluctance to accelerate.

Some Definitions

Force is that which tends to produce motion in a body, to change that motion, or to keep the body at rest. *Mass* has been called the amount of matter (or stuff) in a body, the product of volume and mass density, but there is inherent in mass a property which offers resistance to change in motion, this property being called *inertia*, which is greater the larger the mass. This aspect must not be neglected, as the polar moment of inertia has to be used in problems on rotating machines. Mechanical engineers use the pound for both force and weight and students get tangled up with where to put "g," but the electrical engineer must also be able to use the gravitational or engineer's unit of force.

If a body of weight (mass) 1 kg falls and is acted upon by gravity with a force of 1 kg, its acceleration "g" is 9·81 metres/sec^2. It can be shown experimentally that P=kmf, where P=force, m=mass, f=acceleration and k is a constant depending upon the units chosen for P, m and f. In this equation, if P=1, m=1, f=9·81 then $1=k\times1\times9{\cdot}81$, hence k=1/9·81,

$$\text{or } \frac{P}{m}=\frac{f}{g} \quad \ldots\ldots\ldots\ldots\ldots\ldots\ldots\ldots(1)$$

This is the easiest form to use with force and weight in similar units. By definition in the M.K.S. system, k is unity, as a force of 1 Newton accelerates a mass of 1 kilogramme at 1 metre/sec^2.

$$1\ P(Nw)=1x1(kg)\times1(m/sec^2) \quad \ldots\ldots\ldots\ldots\ldots\ldots(2)$$

In gravitational units, using pounds for weight and force, generally $P=\frac{W}{g}f$ is used instead of (1). From (2) with conversion factors 1 lb=0·4536 kg and 1 m=3·281 ft

$$1\ Nw=\frac{1}{0{\cdot}4536}\ lb.\times1\times3{\cdot}281\ ft/s^2.$$

If left like this the product would be "poundals," so for the *force* to be in lb wt the value of "g" in these units, 32·2 ft/s^2, must be inserted in the denominator, hence—

$$1\ Nw=\frac{1}{32{\cdot}2}\times\frac{1}{0{\cdot}4536}\times1\times3{\cdot}281=0{\cdot}225\ lb\ wt.$$

Energy and Work.—Energy is the capacity of doing work and the units are the same. In the M.K.S. system, work=Metre-Newtons, often given as Newton-Metres (Nw-m) or Joules. In the gravitational system, work=ft-lb.

$$1\ Nw\text{-}m=1\times0{\cdot}225\ lb(wt)\times1\times3{\cdot}281\ ft$$
$$=0{\cdot}7382\ lb\text{-}ft.$$

$$\text{or } 1\ ft\text{-}lb=\frac{1}{0{\cdot}738}=1{\cdot}36\ Joules.$$

Power is rate of doing work, but—

$$1\ J/s=1\ watt=1\ Nw\text{-}m/sec.$$

Horse power.—1 h.p.=550 ft-lb/sec. and as

$$1\ Nw\text{-}m=0{\cdot}738\ ft\text{-}lb,\ 1\ hp=\frac{550}{0{\cdot}738}$$
$$\text{or } 550\times1{\cdot}36=746\ watts.$$

A familiar type example may be considered to illustrate the case of these units. An electric tram weighing 6 tons is accelerated from rest to 15 m.p.h. in 15 seconds up a gradient of 1 in 40. If the resistance to motion is 15 lb/ton, calculate (a) the total force required, in lb/wt and newtons. This will be worked out both in Gravitational and in M.K.S. units.

(i) Force to overcome resistance to motion
$=15\times6=$ 90 lb

(ii) Force to accelerate, from $v=u+ft$, $v=88/4$ ft/s and $u=0$

$\therefore f=22/15$ ft/s^2.

$$P=\frac{W}{g}f=\frac{6\times2240\times22}{32{\cdot}2\times15}=612\ lb$$

(iii) Force up incline,

$6\times2240\times1/40=336$ lb

Total 1038 lb wt.

In M.K.S. units:—

(i) Force to overcome resistance to motion $= \frac{15 \times 6}{0{\cdot}225} =$ 400 Nw.

(ii) Force to accelerate, as 1m = 3·28 ft, v = 22/3·28 = 6·7 m/s and as 1 lb = 0·454 kg, 6 tons = 6080 kg. Acceleration f = 6·7/15 = 0·447 m/s². As k = 1, "g" does not enter into the calculation.

$$Nw = kg \times m/s^2 = 6080 \times 0{\cdot}447 = 2720 \text{ Nw.}$$

(iii) Force up incline $= \frac{6 \times 2240}{40 \times 0{\cdot}225} = 1490$ Nw.

Total force = 4610 Nw.

As a check, 4610 × 0·225 = 1037 lb wt, which agrees with the first answer.

Torque.—Using the Metre-Newton (m-Nw) like ft-lb for work, then as lb-ft is customary for torque, the unit of torque is the Newton-metre (Nw-m). When a torque of T Nw-m is exerted through an angle of θ radians, the work done is Tθ m-Nw or *Joules*. *Power* is the rate of doing work, hence it can be expressed as $T\frac{d\theta}{dt}$ m-Nw/sec, but $\frac{d\theta}{dt}$ is angular velocity ω in radians per second.

But 1 m-Nw/s = 1 Joule/sec = 1 watt, hence

Power = Tω watts.

FAN-COOLED TRANSFORMERS

FORCED-AIR cooling is a method particularly applicable to large transformers, and it is estimated in a recent American I.E.E. paper that 75% of all power transformers of 10 MVA and over are equipped with fans at the factory, many more being applied in the field. The paper "Modern Forced-Air Cooling of Power Transformers," by Mr. W. D. Albright, discusses American practice in this respect from a number of angles.

Methods of Application

There are various methods of applying forced-air cooling, one of the most popular being to build the transformer with enough radiators to self-cool the average load, and provide fans to take care of peak loads and unexpected overloads. Continuous fan operation, however, offers certain advantages. When the transformer is supplying a steady load and fan noise is of little consequence, continuous operation will permit the purchase of a smaller transformer. Even when the load cycle would permit occasional shutting down of fans, continuous running may be advantageous. The lower copper temperatures obtained should more than compensate for additional power required by the fans, giving an overall decrease in total loss.

Limits of Use

Usual designs of large forced-air cooled power transformers allow for a one-third increase in load when fans are running. When a two-thirds increase is required, it is more practicable to use a combination of fans and oil-circulating pumps. Most self-cooled transformers can be equipped with fans in the field to obtain some increased capacity, but when the unit was not originally designed for future application of fans, the internal parts such as leads, tap changers and bushings may prove a limiting factor.

Fan Requirements

Fans for transformer cooling duty in America deliver from 3,000 to 7,500 cu ft/min, with leaving velocities of 1,000 ft/min. Care has to be taken that the noise level is kept well down, though the relevant N.E.M.A. standards permit in general a 3 decibel increase in noise level when forced-air fans are applied to a self-cooled transformer. This means in effect, that the fans may be equally as noisy as the self-cooled transformer alone.

Where noise level is of particular importance, it may be necessary to keep the fan speed relatively low. Cast-aluminium blades are found to have advantages from the noise aspect over the sheet metal type of blade. Another point that has to be watched is the transmission of vibration from the fan. There is at present a preference for an extremely rigid mounting in preference to the use of rubber or neoprene supports. Flexible neoprene connecting cables are used to supply the fans, rather than metal conduit which might transmit vibrations.

Motors are usually of the totally enclosed, weatherproof variety. Three-phase or single-phase capacitor-start capacitor run machines are preferred. If the latter type are used, it is possible that a natural breeze will be turning the fans in the reverse direction, and that they will then start up like that—with the fans working inefficiently. Though this is not an insuperable difficulty, the preference does lie with the three-phase motor.

Mobile Cranes

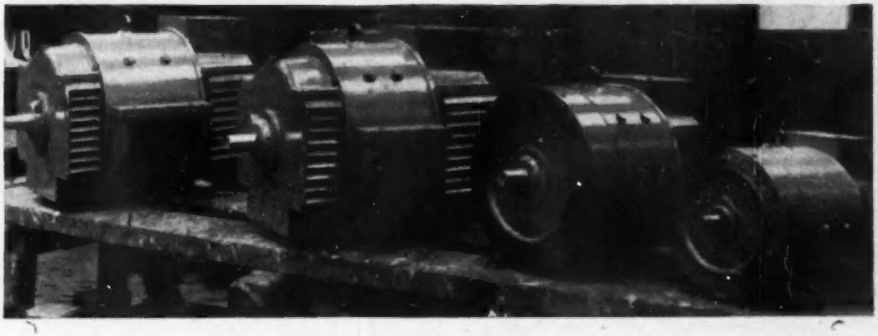
—*Diesel-electric drive simplifies control and operation*

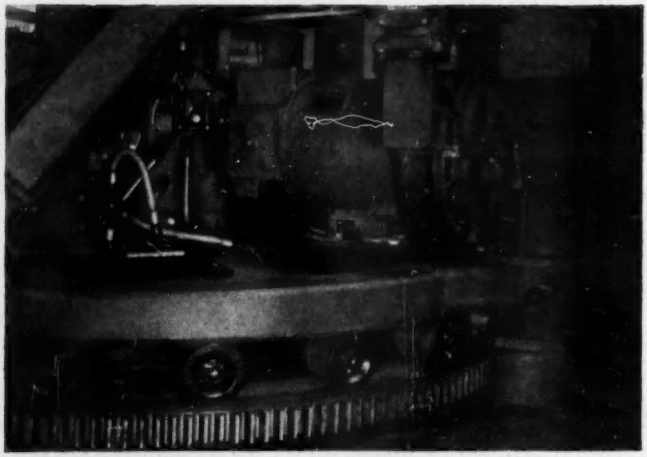
THE use of mobile cranes has rapidly increased in the past few years and one of the latest types to be developed is a diesel-electric powered unit produced by Walker Bros. (Wigan) Ltd., Wigan, England.

This is a pneumatic-tyred, rigid, six-wheel vehicle with good manoeuvrability in confined spaces and is one-man operated. All vehicle and crane controls are arranged inside the driver's cab from which the operator has a full view of the crane, which is capable of slewing through 360° in one-third of a minute. Retractable outriggers are provided if loads of 8 tons are to be lifted at the maximum radius of 10 ft, but loads of up to 6 tons can be lifted and carried at this radius without their use. They can be brought into use in 45 seconds.

The main power unit consists of a 4LW Gardner diesel engine which is directly coupled to a 32 kW d.c. generator manufactured by the Electric Construction Co., Bushbury Engineering Works, Wolverhampton, who were also responsible for the manufacture of the traction motor and the crane motors. This generator has a nominal rating of 335 volts, 1,700 r.p.m., 32 kW and is of the drip-proof, steel yoke pattern and is plain

Above, in our heading block, we show the Walker 6-8 ton diesel-electric crane in use at Lawley St. (Birmingham) depot of British Railways (London Midland Region). Below are the four E.C.C. motors





View of main slewing motor and drive assembly

shunt wound. As during traction or crane operation, the speed of the motors is entirely controlled by the voltage produced by the generator, and this is in turn dependent on the speed of the diesel, full control is provided by the accelerator pedal in the driver's cab. The diesel itself is governed automatically to give two maximum speeds. One of 1,700 r.p.m. for travelling and one of 1,300 r.p.m. for crane operation. In the former condition, the engine output is 75 b.h.p. and in the latter, the output is reduced to 59 b.h.p.

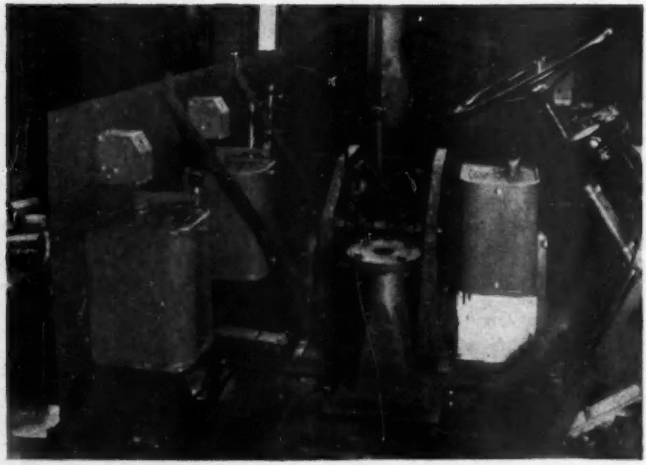
In order to obtain stability under low voltage conditions, the field system of the generator has been suitably modified.

The traction drive consists of a 36 b.h.p. 335 volt 1,500 r.p.m. rated (continuous rating) series-wound motor of the drip-proof type coupled to a propeller shaft carried in needle roller bearings. Fitted in the bogie are two worm - driven axles each fitted with a differential gear. Live axle centres are 4ft 6in. When driving, the accelerator is depressed in the manner normal to other road vehicles, and a similar pedal for power control is provided for use when the driver's seat is turned through 180° and the driver is facing rearwards. It should be noted that there is no gearbox (apart from the rear axle drives) in the transmission system, although consideration is being given to the fitting of a two-speed unit if found necessary. The performance under normal conditions is 10-15 m.p.h. on the level, and the crane can negotiate gradients in the neighbourhood of 1 in 10.

In craning conditions, the driver uses a hoisting motor control in the form of a reversing drum type, spring-return, which is located at his right hand, while for slewing, a similar control is provided, located on his left side. The hoisting motor is a 16½ b.h.p., 230 volts, 750 r.p.m. (½ hour rating) totally enclosed series wound unit, while the slew motor is of 3 b.h.p. at 500 r.p.m.

A patent gear is provided which enables the main hoist motor to be used also for derricking, and is arranged so that as the jib moves, the bottom block remains horizontal.

Our thanks are due to Mr. C. B. Walker of Messrs. Walker Bros., for the information given and to E.C.C. for the photographs.



Driver's cab, under construction to show layout of controls

B.E.A. Grid Reinforcement

New 132 kV Substation at Oldbury

THE new B.E.A. substation of the Midlands Division at Oldbury is of the 3-switch "Low" type and was designed by the Authority to allow for future extension to a double busbar station. Two 132 kV feeders are connected to Nechells and Ocker Hill generating stations, and two 45 MVA transformers step down this voltage to 33 kV for distribution to the surrounding area.

Transformers

Each transformer is fitted with 132 kV on-load tap-changing gear, and is arranged for automatic voltage control, the necessary relays being mounted on the control board in the electrical plant house. Local tap-change controls are mounted in a control and marshalling kiosk which is situated by the transformer and also houses temperature indicators and cooler controls. Connections are taken from the delta secondary winding of each transformer to the primary of an earthing transformer, the star point of which is connected, through a pole-operated isolator, to a liquid earthing resistor having a 30-second rating of 750 amperes. This earthing transformer also provides various 415/240 volt auxiliary supplies.

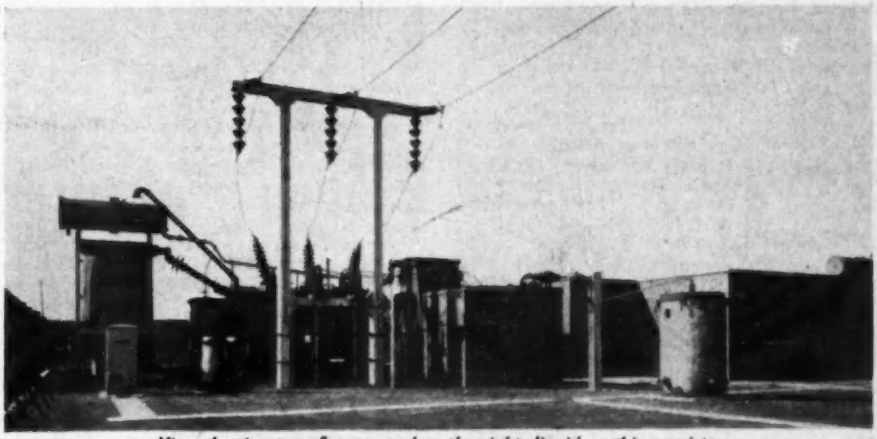
The three 132 kV, 2,500 MVA oil circuit-breakers which, together with the transformers were made by G.E.C., each comprise three single complete single phase units which are linked by pull-rods to a kiosk containing the operating mechanism.

Triple pole isolators of the double break rotating type are also fitted, and have a current rating of 600 amperes. All oil circuit-breakers, isolators and earthing switching are fully interlocked on a combined electrical and Castell system.

Protection

Protective equipment and local control gear are installed in the relay and control room in the electrical plant house, a single-storey building situated at one end of the site between the two main transformers. A sheet steel cubicle type relay panel is provided for each transformer and each feeder. Transformer protection is provided by G.E.C. overload and balanced earth fault protection, while Solkor and Reyrolle high-speed ratio balance are provided for the Ocker Hill and Nechells feeders respectively. In each case, the back-up protection consists of a triple-pole overcurrent relay manufactured by the G.E.C., who also supplied the tripping relays through which all the protective systems operate.

Acknowledgments are due to the B.E.A. Divisional Controller, Midlands Division, for assistance in obtaining photographs of the substation and for permission to publish the foregoing information.



View showing transformer, and on the right, liquid earthing resistor C

overseas news

Another Dollar Order

An order for the supply of a 66 MW, 3,600 r.p.m. steam turbo-alternator has been placed by the Calgary Power Co., Canada, with the Metropolitan-Vickers Electrical Co. Ltd. This set, which is the initial unit for a new power station to be built by the Calgary Co., at Wabamun, near Edmonton, Alberta, will consist of a two-cylinder turbine operating with inlet steam conditions of 1,250 p.s.i.g., 950° F, and driving a hydrogen-cooled 13,800 V a.c. generator. The contract, valued at over £530,000, was obtained in the face of severe competition from German, Swiss and U.S.A. firms.

Duel Frequency Frig.

An agreement has been signed by the Hydro Electric Power Commission of Ontario with two more refrigerator manufacturers, under which the companies will make machines that are able to operate on either 25 or 60 cycle systems, and thus saving the Commission the cost of eventual conversion. It is estimated that it costs an extra 17% to manufacture the special unit including development costs; the Commission allows this to the companies and saves approximately 83% of the cost of conversion of a straight 25-cycle model, roughly $100. The two companies concerned in this new agreement are Kelvinator of Canada Ltd. and Frigidaire Products of Canada Ltd. A similar agreement was signed earlier this year with the Canadian Westinghouse Co. The latest agreement follows months of research by the companies involved with aid supplied by the Commission which in 1952 produced a prototype model of a dual-frequency refrigerator unit. The saving to the Commission, after deduction of development expenses and payment of the extra manufacturing costs, is estimated at $3-4 millions in the first year. Westinghouse units are already on the market.

U.S. Electrical Imports and Exports

Imports of electrical machinery and equipment into the United States during 1952 were twelve times higher than they were immediately before the second world war. This is stated in a report prepared for the National Electrical Manufacturers' Association by a business research organisation. The report, which shows that U.S. exports of the same products in 1952 were only six times higher than those of pre-war, has been presented to the Commission on Foreign Economic Policy. According to the report, sales of foreign electrical equipment in the U.S. in the first six months of 1953 were 50% up on the same period of 1952, whereas U.S. export sales of such goods in that period rose by only 9%, and actually dropped 7% if sales to Canada are excluded. As an indication of the growing keenness of foreign competition, it is stated that 8% of foreign quotations on public tenders for electrical equipment in Latin America and Asia in the 18 months examined in the report were lower than U.S. bids by an average of 20%.

A Manufacturer's View

Following the publication of the report noted above, Mr. Philip Reed, chairman of the board of the General Electric of America, has made the suggestion that American producers of heavy electrical equipment should have protection against imports by foreign competitors. He asserted that for Japanese manufacturers, their labour costs were only 10% of those in the United States, while labour costs in Europe generally ran about 25% lower than those in America. While agreeing that U.S. markets should not be closed to foreign trade, he also believed that foreign competition should not be permitted to enter those markets at prices so low that no American producer could meet it. Mr. H. Erben, executive vice-president, stated that American producers could hold their own in electric home appliances as mass production methods offset the spread in labour costs. But in the field of turbines, generators and other large industrial equipment, careful hand-work was essential, and American firms could not compete with foreign manufacturers having low labour costs. He suggested that in such cases something should be done to equalise competition.

Loans for Brazil

The International Bank for Reconstruction and Development has approved two loans to Brazil for railway transport and hydro-electric projects. One hundred new electric passenger trains will be purchased under a loan of $12,500,000 to the Central Railway of Brazil for its Rio de Janeiro suburban system. A loan of $10 million has also been approved for a Usinas Eletricas do Paranapanema Company for construction of a dam, power plant, transmission line and substations for the company's Salto Grande hydro-electric project. In regard to the electrification of the Rio de Janeiro suburban railway system, it is reported that a British firm has submitted the best tender. It is suggested that the firm in question is Metropolitan-Vickers Electrical Co. Ltd. Over $20 million are to be spent on improving the railway service, including the purchase of 100 electric motor-driven cars, 100 trailer cars, along with other components and spare parts. The Salto Grande hydro-electric project is one of many which Brazil has in preparation, and for which loan funds have already been obtained.

Appliance Production

In addition to Poland, whose plan to expand production of domestic electrical apparatus we noted on December 17, Hungary is also now proposing to give more mechanical aid to the housewife. The Hungarian Ministry of Machine Industry has approved plans for the manufacture in 1954 of £3,000,000 worth of washing machines, refrigerators, vacuum cleaners and mincers.

Indian Undertakings' Needs

The urgent need for an increase from 5% to 6% in the permitted return on equity capital to electricity supply companies in India, has again been emphasised by Mr. K. G. Milne, in his presidential address to the Federation of Electricity Undertakings of India. He stressed that conditions had changed greatly since the rate had been fixed under the 1948 Act. Under the country's Five-Year Plan private enterprise was allotted the responsibility of installing 200 MW of plant. If that target was to be achieved, it would be necessary for the concerns to attract large amounts of new capital. But while the rate of return remained at 5% it was doubtful if sufficient capital would be forthcoming. To indicate the extent of the company side of the industry, he stated that at the end of December 1951, there were 451 electricity supply undertakings in the country, of which 227, or 54·5% were company-owned. The latter accounted for 61·95% of the total installed capacity, and generated 58·04% of the total electrical energy.

Station Contract

The consideration by Brisbane City Council of tenders for construction of the second section of the Tennyson power station was the occasion of strong comment, we learn. The Stores Board had recommended that the contract should be placed with Evans, Deakin and Co. Ltd. whose price of £231,120 was £18,700 above the lowest tender. That firm tendered to complete the work in 20 months; whereas Electric Power Transmission Pty. Ltd., of Sydney, N.S.W., who submitted the lowest tender, proposed to complete the job in 24 months. The Stores Board's chairman, Mr. J. C. Slaughter, who is also town clerk, agreed with the majority view of the Board members in awarding the contract to Evans, Deakin and Co., but the Works Department chief engineer, Mr. C. B. Mott, dissented from that decision.

Another River Scheme

Preliminary investigations into the possibilities of hydro-electric schemes on the Kaituna River, New Zealand, have now begun. Three power stations with a total capacity of 90,000 kW are envisaged by the State Hydro-Electric Department. A number of schemes to utilise the river have been considered but a diversion tunnel from either Cherry Bay or Otaramarae Bay seems the most likely proposal. This would bring the water to three miles below Okere Falls where it would drop more than 500 ft to a power house set in a steep gorge. It is estimated that 40,000 kW could be generated at that site. But the main obstacle to that proposal is the presence of thermal activity in the region. The tunnel would go through the Taheke Maori land development block, on one side of which are a number of hot springs. Drillings now being made should ascertain the extent of these hot subterranean streams.

Improved Supply

Another bulk supply point is to be established by the Central Waikato Electric Power Board, New Zealand. The site of the new tap-off is to be near the Board's northern boundary at Maramarua. Additional power is needed in the area because of new mills and the increasing demands of coalmines. Power will be tapped from a State Hydro Department 50 kV line at present running into Kerepehi.

Gas Co. Take-over

The Ashburton Gas, Coal and Coke Co., New Zealand, is being purchased by the Ashburton Electric Power Board. The latter is to make an offer to the company to take over its works and plant as a going concern. This decision followed 20 months of consideration and considerable Government pressure. The Board offers to take over all assets and liabilities and to pay the company 10s in the £ of share capital. If this offer is finally accepted the board will carry on the works as long as they can be worked efficiently. The board will continue to give a full supply of gas to all present consumers and will permit a change-over from gas to electricity only in exceptional cases.

Owen Falls Nearly Ready

The first 15 MW turbo-alternator at the Owen Falls hydro-electric station of the Uganda Electricity Board began turning on Tuesday of last week, as part of the drying-out process before being put into commercial operation. This is the first of four such machines which are to comprise the initial section of the station. Two more are on order for the second section, and there is a likelihood that a further four machines will be added at a later date. The alternators are being supplied by the British Thomson-Houston Co. and the water turbines by Boving and Co. Ltd. The order for the civil construction work was placed in September 1949 with a group headed by Christiani and Nielsen Ltd. Before the first turbine could be started, it was necessary to raise to 45 ft the water level held by the dam. At the first attempt about three weeks ago some sheet-steel piling which had been used to seal the last gap in the dam buckled under the pressure. Afterwards hundreds of tons of rock, strengthened with cement, was forced in under pressure to buttress the special gate before the gap was closed again.

PERSONALITIES
IN THE INDUSTRY

For the post of station superintendent at Taylor's Lane power station, London Division, B.E.A. **Mr. W. A. Rollo** has been chosen. Mr. Rollo, who now holds a similar position at the Division's Grove Road generating station, will succeed **Mr. E. W. Tapp,** B.SC.(Eng.), A.M.I.E.E., who has been promoted to station superintendent at Fulham, as we have already reported. Mr. Rollo has been superintendent at the Grove Road power station since 1951, after about five years as chief assistant there. He joined the former London Power Co. in 1926 and occupied several staff positions at Deptford West and Acton Lane stations, in addition to Grove Road.

Mr. W. A. Rollo

Appointed as deputy sub-area engineer for the Birmingham and District sub-area of the Midlands Electricity Board is **Mr. J. T. Clewley,** A.M.I.E.E., A.C.T.(B'ham), who was previously senior assistant engineer in that sub-area. Educated at Handsworth Technical School and Birmingham College of Technology, he joined the Birmingham Electricity Supply Department in 1930. Various promotions followed and from 1946 to 1948 he was district engineer for North West Birmingham. With the nationalisation of the industry, he served as district engineer at Sutton Coldfield until 1949 when he became district manager there to the Board, holding that position till 1951 when he went to the sub-area.

Mr. D. F. R. Evans has been invited to join the board of the General Cable Manufacturing Co., as from January 1. He is a director of F. McNeill and Co., and is associated with Kemsley Newspapers.

A divisional engineer in the chief engineers' department of the London County Council, since April, 1950, **Mr. J. Galloway,** M.I.E.E., is shortly to take up an appointment as regional engineer with the North Western Metropolitan Hospital Board. Educated at Dumbarton Academy and Glasgow Technical College, Mr. Galloway afterwards spent some time in India on behalf of McKinnon, McKenzie & Co. Since joining the L.C.C. in 1928, he has been in charge of the engineering equipment in the completion of County Hall, and for the new county offices. He was also responsible for the design of the engineering equipment for the Concert Hall in the South Bank scheme.

At present secretary of the South Eastern Electricity Board's Surrey sub-area, **Mr. D. A. Green,** A.C.A., F.C.I.S., has been appointed section head in the Secretary's Department at the Board's headquarters. His position as Surrey sub-area secretary is being taken over from January 1 by **Mr. L. H. Kemp,** A.I.M.T.A., who was previously the assistant sub-area accountant there. Mr. Green will succeed **Mr. Sidney D. Brown,** who is retiring in March next. Prior to vesting day Mr. Green was secretary to the Electric Supply Corporation (Overseas) Ltd., Mr. Kemp joined the Board in 1948 after eighteen years in the Borough Treasurer's Department at Kingston-upon-Thames.

The Council of the University College of South Wales and Monmouthshire has appointed as its first professor of electrical engineering, **Prof. Emrys Williams,** B.ENG., PH.D., M.I.E.E., who at present holds a similar post at the University College of North Wales, at Bangor. He has been at Bangor since 1947 and was previously lecturer in electrical engineering at King's College, Newcastle-upon-Tyne. Before going to Newcastle, Dr. Williams was a member of the scientific staff in the Research Laboratories of the General Electric Co., Ltd., at Wembley. He was chairman of the Radio and Measurements Group of the North Eastern Centre of the I.E.E., for the 1946-47 session.

The Stella Lamp Co., Ltd., has made two new appointments to its sales staff. **Mr. J. Biggs** is now representative in Lancashire, and **Mr. K. V. Issott** is to act similarly in Yorkshire. Mr. Biggs was for 19 years with the former Bolton Corporation Electricity Department—later the North Western Electricity Board—and for the past six years has been concerned with the sale and installation of electrical appliances. Mr. Issott was on the internal sales staff of A. C. Cossor, Ltd., for ten years before the war, Since 1950 he has been the sales representative in parts of Yorkshire for T. B. Morley & Co., Ltd., the electrical manufacturers and wholesalers.

Mr. J. Biggs

Mr. K. V. Issott

At present charge engineer at Southport power station, Merseyside, and North Wales Division, B.E.A., **Mr. W. M. Gore** is to take up the appointment of operation and efficiency engineer at St. Helens generating station in the same Division on January 18. He has been in the Supply Industry for nearly 38 years, and has previously served at Atherton, Bradford, Radcliffe (Lancashire Electric Power Co.), and the Dickinson Street power station at Manchester. He has been a contributor to the ELECTRICAL TIMES in the past.

Mr. W. M. Gore

The Minister of Fuel and Power has re-appointed **Dr. P. Dunsheath,** C.B.E., M.A., M.Inst.C.E., M.I.E.E., F.Inst.P., and **Mr. G. C. R. Eley,** C.B.E., M.A., as part-time members of the London Electricity Board. As **Mr. W. J. H. Wood,** M.I.E.E., M.I.Mech.E., is retiring on completion of his term of office, **Mr. E. A. Mills,** M.Inst.C.E., M.I.E.E., M.I.Mech.E., who as we have already noted is relinquishing the deputy chairmanship of that Board today, December 31, is to remain on the Board as a part-time member. The Minister has also re-appointed **Mr. R. W. McCrone,** M.C., B.Sc.(Eng.), A.M.Inst.C.E., and **Sir Ronald Thomson,** D.L., as part-time members of the South East Scotland Electricity Board, and **Mr. G. K. Paton,** M.I.E.E., in a similar capacity with the Merseyside and North Wales Electricity Board. **Sir Arthur Pickup** is retiring from the latter Board today, December 31, on completion of his term of office.

The Bombay Municipal Corporation has decided to extend the term of office of **Mr. J. P. L. Shenoy** as general manager of the Bombay Electric Supply and Tramways Undertaking for a further period of two years. His present term of office was due to expire on February 7 next.

Mr. J. W. Rogers, B.E., A.M.I.E.E., for the past six years engineer to the Waitomo Power Board, New Zealand, is relinquishing that post to take up a position with the Bay of Plenty Power Board, early next year.

The B.B.C. has appointed **Mr. L. Evans** as engineer-in-charge of the low-power television transmitting station near Douglas, Isle of Man. He has had experience at the Sutton Coldfield and, more recently, at Wenvoe television transmitting stations.

The many friends of Mr. W. E. Jones, M.I.E.E., the former borough electrical engineer and manager of Basingstoke, will be interested to hear that his only child, Audrey Irene, was married at Ewell, Surrey, recently to **Mr. Peter H. C. Jennings,** B.A.

Mr. William H. Draper, Jr., who earlier this year retired from the position of U.S. Special Representative in Europe, is to become chairman of the Board and chief executive officer of the Mexican Light and Power Co., Ltd., as from April 1 next. He will succeed **Mr. George S. Messersmith,** the present chairman and chief executive officer, who has asked to be relieved of his duties as from March 31, 1954. The Board has acceded to this request on the understanding that Mr. Messersmith will remain on the board as honorary chairman.

Mr. C. W. Cosgrove, B.Sc.(Eng.), has been appointed as general manager of the Osram-G.E.C. group of factories, in succession to **Mr. E. R. Gant,** who recently retired. Mr. Cosgrove joined the M.O. Valve Co., Ltd., an associated company of the G.E.C., in 1922, to found a development laboratory. He was appointed assistant works manager of the M.O. Valve Co., Ltd., in 1940 and ten years later became works manager. In 1951 he was promoted to assistant general manager of the Osram-G.E.C. group of factories, and of the M.O. Valve Co., Ltd. Mr. Gant joined the Robertson lamp works of the G.E.C. in 1910, and in 1918, at the age of 25 years, became a superintendent in the Osram-G.E.C. lamp works at Hammersmith. In 1930 he was appointed assistant manager of the M.O. Valve Co., Ltd., and in 1940 was promoted to general manager of the Osram-G.E.C. group of factories.

From tomorrow, January 1, **Mr. W. J. Henton-Jones,** D.S.O., R.D., A.M.I.Mech.E., M.I.Mar.E., takes up his new duties as superintendent at Agecroft H.P. power station in the North Western Division of the B.E.A. Since 1948 he has been deputy superintendent at the Division's Kearsley power station. Educated at Bridgend Grammar School, he received technical training at Cardiff Technical College and served his apprenticeship with Hills, Drydock and Engineering Co., From 1929 to 1938 he served at Radcliffe power station as shift charge engineer, and later as deputy resident engineer. In 1939 he was mobilised as Lt. Commander (E) R.N.R., and was later promoted to the rank of Commander, being mentioned in dispatches in April 1941, and awarded the D.S.O. in June 1942, for bravery in a battle for the relief of Malta. He later served in the Far East in H.M.S. *Glory* and retired from the R.N.R. in 1948 with the rank of Commander (E). From 1946 he continued his service as shift charge engineer at Kearsley power station until 1948, when he was promoted to deputy superintendent.

Mr. W. J. Henton-Jones

Formerly second assistant engineer in the Transmission Department of the North Eastern Division of the B.E.A., **Mr. S. Smith** is appointed senior assistant engineer with effect from January 1, 1954.

Prior to serving with the Division, he was with the North Eastern Electricity Board and also the former North Eastern Electric Supply Co., Ltd., having joined the staff of the latter after serving an apprenticeship with Metropolitan-Vickers Electrical Co. Ltd.

Mr. Louis E. J. Halsey and **Mr. F. S. Maffin,** A.C.A., both senior employees of long standing, have been appointed to the board of Dictograph Telephones, Ltd. Mr. Halsey retains his present position as secretary of the company.

Power and radio engineer for the South-Western Region of the Post Office, **Mr. Arthur S. West** retires today, December 31, after 43 years' service with the G.P.O. Before going to Bristol in 1931 he was closely associated with important development activities, including work on the Beam radio system.

OBITUARY

Mr. J. E. Hodgkin, R.B.A., F.S.A., M.I.E.E., who died on December 19, aged 78, began his career with Ernest Scott and Mountain, Ltd., electrical and mechanical engineers of Newcastle-upon-Tyne, and later went into business on his own account as Hodgkin and Young, Ltd., at Darlington. Subsequently he became a director of many other concerns. He was also a keen amateur archaeologist.

Mr. J. H. W. Pawlyn, chairman of Ransomes Sims and Jefferies, Ltd. from 1939 to 1951 when he became deputy chairman, died on December 20, aged 78.

Mr. William Griggs, who retired from the service of the General Electric Co. Ltd., in October, 1932, after fifty years with that concern, died on December 21, aged 89. He was the first member of the staff to be engaged by Hugo Hirst (later Baron Hirst of Wilton).

Mr. L. G. Walker, managing director of West Wales Electric Co., Ltd., died on December 17.

Mr. S. H. Heywood, chairman of S. H. Heywood and Co., Ltd., manufacturers of electric cranes, died recently, aged 85.

NEW LITERATURE

The M.K.S. System of Units

by T. McGreevy, M.SC. (Tech.), M.I.E.E.

THERE is little doubt that the rationalised M.K.S. system of units has come to stay, although the C.G.S. system is unlikely to disappear altogether from technical studies. As with all new systems, it is the transitional period which proves most troublesome—on the one hand are engineers who have been brought up on the old system, on the other the graduates and students conversant with the new. Yet for the two groups to co-operate a common medium for information is necessary. To this end the author has devoted his excellent book, which is concerned with explaining the M.K.S. system to those engineers and lecturers who have hitherto used only the C.G.S. system.

The subject has been approached on two lines, firstly by way of the C.G.S. units to explain the system and secondly by the author's own method as a suggested way of introducing the system to students who will be learning technology in M.K.S. units *ab initio*. In the first section a brief historical introduction is followed by a discussion of relationships between various systems. This shows how a complete system (M.K.S.) can be built up from the existing "Practical System" of electro-magnetic units together with additional new units which are introduced to ensure completeness and to eliminate conversion constants. From this the theme is developed, dealing successively with mechanical units, electrostatics and formulae conversion. The second part gets under way by a general discourse on the new techniques required to teach electrical technology on the M.K.S. system. A comparatively simple system is developed for part-time students, and the subject is then covered more fully to meet full-time training requirements. Both methods make magnetostatics as the medium by which the subject is introduced—electrostatics being derived from this basis. The concluding chapter, however, discusses methods using the alternative (and perhaps more correct) way, in which the theory of electricity and magnetism is based upon electrostatics, for those who prefer this approach. Published by Pitman, 283 pages, 7¼ in. by 4¾ in. Price 21s.

BOOKS RECEIVED

Data and Circuits of Television Receiver Valves, by J. Jager. No. IIIC in the Philips Technical Library series on electronic valves, for the practising engineer. Published, for Philips Technical Library, by Cleaver Hume, 214 pages, 9 in. by 6 in. Price 21s.

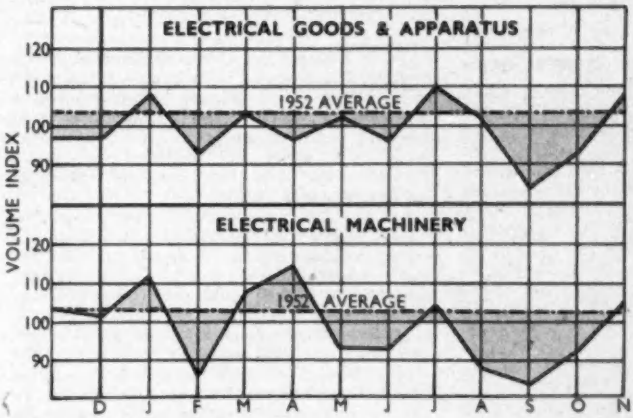
Relays for Electronic and Industrial Control, by R. C. Walker. For engineers, collecting for handy reference principal features and possibilities of relays. Published by Chapman and Hall, 303 pages, 8½ in. by 5½ in. Price 42s.

Statistical Methods in Electrical Engineering, by D. A. Bell. Concise work on theory and applications, designed by both students and engineers. Published by Chapman and Hall, 175 pages, 8½ in. by 5½ in. Price 25s.

An Introduction to Power System Analysis, by F. S. Rothe. Covers fundamental elements in design of modern power system, for students and graduate engineers. Published by Chapman and Hall, 187 pages, 9 in. by 5¾ in. Price 40s.

Low Frequency Amplification, by Dr. N. A. J. Voorhoeve. Deals with design and use of equipment, primarily for sound engineers. Published for Philips Technical Library by Cleaver Hume, 495 pages, 9 in. by 6 in. Price 50s.

EXPORTS AND IMPORTS



EXPORTS VOLUME INDEX

November exports of electrical equipment, in both categories, showed a marked increase over those in previous months. For electrical goods and apparatus, the Volume Index rose by over 10 points to 108, the highest value since July. This compares with 97 for November last year, 1950 being the base year of 100 in both cases. In value, the exports in this class amounted to £9,760,238.

Turning now to electrical machinery, the Volume Index for this group rose to 105, 12 points higher than the previous month, compared with 103 for November 1952. The base year is also 1950 as 100. Exports of electrical machinery amounted to £5,234,283 in value.

THERE was a substantial increase in the value of all electrical goods exported during November. Following on October's increase, last month's figures are now much more comparable with the records achieved a few years ago. The total of £15,599,957 value of goods sent abroad in November is well over £2 million more than in October. Most items showed a rise in their individual figures, the most spectacular being for cables, the convertors, rectifiers and transformers group, and radio apparatus. The latter added another £200,000 to its previous record figure—that for October last. Small electric washing machines £366,076 in value were exported in November, along with £159,722 worth of larger models.

Description	Exports Value Month of November			Imports Value Month of November		
	1951 £	1952 £	1953 £	1951 £	1952 £	1953 £
Telegraph and Telephone Wires and Cables—						
Submarine	25,296	—	22,659	—	—	—
Other	469,992	902,245	745,557	—	—	—
Rubber Insulated	807,520	431,746	386,937	—	—	—
Insulated, other than Rubber	1,045,008	1,327,617	1,348,036	—	—	—
Wireless Apparatus, including Valves ...	2,235,367	2,090,800	2,677,910	308,330	374,986	532,575
Telephone and Telegraph Apparatus... ...	1,840,484	1,286,890	1,517,438	—	—	—
Electric Lighting Appliances, Accessories, Fittings and Parts:—						
Filament Lamp Bulbs...	148,480	78,7[illegible]	113,182	12,036	6,878	23,676
Other Descriptions	425,528	453,882	427,163	80,565	44,483	40,147
Batteries (primary)	242,177	178,504	264,118	—	—	—
Accumulators, Portable	314,193	263,163	232,339	—	—	—
,, Stationary	41,537	56,095	45,434	—	—	—
,, Parts and Accessories ...	78,889	85,816	76,680	—	—	—
Electrical Cooking and Heating Appliances...	555,613	332,533	334,991	—	—	—
Ammeters, Voltmeters, etc., and Parts ...	155,947	154,413	196,270			
House Service Meters	153,409	86,969	112,507	56,648	36,156	58,639
All Other Instruments	113,551	159,591	153,419			
Electro-Medical Apparatus	51,013	50,917	68,147	—	—	—
X-Ray Apparatus, etc.	221,194	100,290	131,253	24,113	39,728	23,407
Insulating Materials	254,918	131,051	131,556	—	—	—
All Other Articles	697,591	576,037	774,640	137,965	122,462	145,733
Total of Group	9,877,707	8,747,316	9,760,238	619,657	624,693	824,177
Electrical Machinery:—						
Generating Sets, Diesel (not exceeding 200 kW)	462,362	276,221	380,783			
,, ,, ,, (exceeding 200 kW) ...	139,934	325,175	314,955	64,132	18,575	52,605
Other Generating Sets	122,518	114,569	79,043			
Generators minus Prime Movers and Parts	386,792	617,160	600,411			
Motors	943,751	863,557	886,988	19,136	29,553	28,090
Convertors, Transformers, Rectifiers, Motor Control Gear, Switchgear, other machinery	3,251,687	3,147,630	3,038,721	19,074	34,202	66,266
Fans, Electrically and Power Driven ...	194,005	232,726	197,080	—	—	—
Vacuum Cleaners or Electrically Operated Appliances	635,216	360,795	341,738	—	—	—
Total Appliances and Machinery	16,013,972	14,685,149	15,599,957	721,999	706,923	971,138

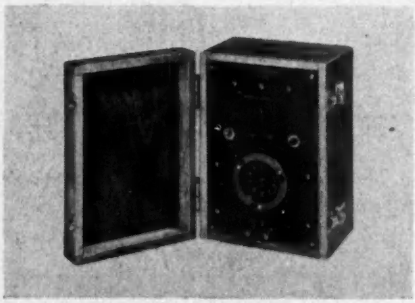
The BUYER'S *Column*

A Time Interval Meter

RECENTLY introduced by CAMERER CUSS AND CO., 56 New Oxford Street, London, W.C.1, developed in association with Allied Electronics Ltd., is a new time interval meter.

The makers claim certain outstanding advantages for their meter. It is self-contained and portable and as the power is provided by two standard deaf aid dry batteries it is independent of errors due to variations of mains frequency.

Start and stop are controlled by closing an electric circuit which actuates a solenoid operating the watch control button, and times can be recorded automatically by means of a standard N.P.L. stop watch incorporated in the instrument, normally the firm's model 308. Control may be over long lines if required due to low current and can be effected by relay, microswitch, or ordinary toggle and bell push switches. An automatic economy switch disconnects battery supply when lid is closed. With many applications in fuel testing, meter testing, fuse testing, etc., the meter is sold complete with model 308 stop watch at £36 10s., or exclusive of watch at £25.



This meter uses any stop watch dealing 1/5, 1/10, 1/50 or 1/100 secs.

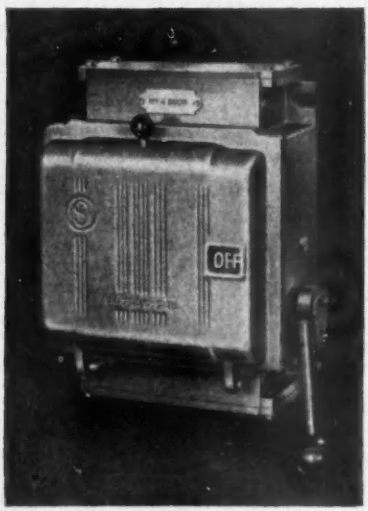
Sander's New Introductions

INTRODUCTIONS of WM. SANDERS AND CO. (WEDNESBURY) LTD., Falcon Electrical Works, Wednesbury, Staffs, are three important items (a) a new "Sandaclad" range of fuse switches; (b) the E.G.613 all insulated consumers control unit; and (c) the U.P.313 all rubber unbreakable 13-amp, 3-pin plug.

The "Sandaclad" range of fuse switches are notable for the ease with which the standard article straight "off the shelf" can be employed in a variety of ways without special modifications. These switches are sturdy yet not cumbersome. They are fitted with a coloured "on-off" indicator to indicate the position of the switch which may be padlocked in position without any modification required. The case lid is interlocked with the switch for safety and has a gasketed lid clamped tight by plastic covered screw to make the unit weatherproof and dust proof. End plates may be drilled and tapped or substituted by sealing chambers which are interchangeable with them.

In the switching mechanism, the movable blades, which carry the cartridge fuse links, are mounted on a light "U" section box. The complete blade assembly is carried on parallel guides. Spring accelerated blades enter heavy gauge copper contact clips which, together with cable terminals are shrouded in porcelain. Rubber buffers are provided to absorb the impact of the sprung blades, effecting a reduction in shock and noise. For maintenance, the blade assembly can be withdrawn by removing two easily accessible screws. When required, neutrals are fitted into the standard t.p. unit below the 150-amp size, whilst in other sizes larger cases are supplied.

The E.G.613 consumers unit was first shown to the trade in March and is a 60-amp d.p microbreak a.c. main switch with mechanical on-off indicator controlling two 5 amp, two 15 amp and two 30 amp. S.p. and n. circuits protected by domestic cartridge fuses to B.S. 1361. The case is a plastic moulding incorporating a metal tray carrying one set of spare fuses. Discs, coloured to the appropriate fuse rating are located on the front of the case and provide space for indica-



The Sandaclad range has style

ting the circuits which they protect. The approximate size of the unit is 4½ in. high by 4 in. wide by 2½ in. deep, the weight without packing being 1¼ lbs. Access for replacement of fuses and for wiring is obtained by sliding the front cover upwards.

The U.P.313 unbreakable plugs are to B.S. 1363 with the exception that the visible earth connection has been omitted as is normal practice for these plugs. Price 36s. 8d. per doz.

"Alumintex" Protective Paint

INVENTED by Dr. Michael Cowan and marketed by the ADELAIDE ENGINEERING CO., 7 Waterloo Road, Liverpool, 22, "Alumintex" is a new type of protective finish which is a compound of aluminium and latex together with other carrying agents.

It can be applied directly to iron and steel, all other metals, wood, cement, asbestos, stone and slate, and can be applied over adherent rust, mill scale and paint. It is also repellent to dry rot, wood worm and fungus.

It is a petroleum mixture which can be applied by brushing or spraying.

Another New "Davey" Fire

THE range of "Davey" electric fires made by A. D. DAVIDSON ELECTRIC CO., 62 Granville Street, Birmingham, 1, was recently increased by the addition of a new reflector fire available in 1 kW (F.220) or 2 kW (F.221).

In this model the reflector is made from chromium plated brass and the sides from chromium plated brass angle section. Each fire is fitted with safety guard to conform with regulations and is supplied with two yards of three core cable. Dimensions of the 1 kW model are 11½ in. high × 13 in. wide × 9 in. deep and price is £2 11s. 6d. plus £1 8s. 3d. tax. The 2 kW model costs £3 16s. plus £2 1s. 8d. tax.

Contemporary "Beta" Lighting

A NEW range of lighting fittings in the contemporary style has been introduced by the BETA MANUFACTURING CO., Poplar Works, Salley Road, Shipley, Yorkshire.

These lamps and wall fittings incorporate the new full-swing swivel which the company has developed and are units of a range which has been accepted by the Council of Industrial Design for inclusion in *Design Review*.

All models are available with either "Swedish" or "bullet" reflectors which can be finished in gold, silver-grey, mustard or cherry. As an example the desk lamp (102S) has a heavy cast base, 15 in. chrome flexible stem and f.s. swivel and Swedish reflector and is wired for use with 60-100 W lamps. Its total height is 20 in. and its price £3 7s. 6d. plus 11s. 3d. tax. The wall brackets are a simple design incorporating the "Swedish" or "bullet" shades and the full-swing swivel on a switched baseplate The table desk lamps employ variations of either "Swedish" or "bullet" reflectors and various types of stems which in common with the swivels are finished in chrome or p. copper.

Hadley Mk. III Intercom Sale

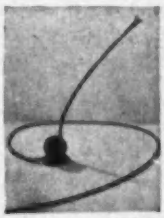
NEW marketing arrangements have been announced by HADLEY SOUND EQUIPMENTS, of Smethwick, Staffs, for their Intercom Mark III system introduced at the B.I.F. this year.

These sets will be marketed through the retail trade, mainly the electrical and office appliance branches and have fixed the prices of the various units offering trade discount.

Prices of the 6-way master unit is £37 10s. and the 12-way master unit £42 10s. Substations standard to both models £4 10s. each.

"Air Column" Microphones

NOW being distributed in this country by G.A. DISTRIBUTORS LTD., 29 Whitehall, London, S.W.1, are a range of German "Air-Column" microphones under the name "Labor."



The Labor MD3T

As is apparent from our illustration the most striking feature of these microphones is the absence of the normal microphone head. The microphone unit is located at the base of the column with only the sound collector head at the top.

There are two models: a desk microphone, MD3T and a stand microphone MD3S. The air-column swivels 360° whilst the solid fitted base plate unscrews the spherical microphone unit. The whole is finished in black stove enamel relieved with chromium rings. The sphere is 2½ in. diameter and the length of the air-column 17 in. The sound collector has a diameter of only ¼ in. the diameter of the air-column being ¼ in. Frequency range 50 c/s to 10 kc/s, sensitivity 0·08 air at 200 ohms. List price £24 10s. The floor standard model is similar but air-column is adjustable from 3 ft 6 in. to 5 ft 6 in. and range 30 c/s to 10 kc/s. Price £22 10s. 4d.

G.E.C. Lighting Introductions

A HEAVY duty flat pocket torch was recently developed by the GENERAL ELECTRIC CO. LTD., Magnet House, Kingsway, W.C.2, which is suitable for inspectors, fitters, meter readers and other engineers.

The body is of rust-proofed steel finished with a high gloss black stove enamel so that the torch will stand up to the roughest use. The length of the torch is 3½ in. It employs a 3·5 V 0·3 A bulb and uses a 4½ V heavy duty battery.

At the same time the company's universal dioptron street lighting lantern has been improved by the complete redesign of the toggle catches which secure the lower dish refractor to the upper refractor. The steel springs have been replaced by alloy castings and simple toggle catches. Externally at each end of the body there is a broad alloy casting. The catch on the casting at the end farthest from the bracket has a toggle action and is hinged to carry the cast alloy ring which holds the lower prismatic glass refractor whilst the other casting carries a toggle catch.

The WEEK in NEWS

Supply Industry's New Salary Scale

INCREASED PAY BACK-DATED FROM APRIL 1952

AGREEMENT has now been reached between the British Electricity Authority and the three organisations concerned, for an increase in pay to various salaried staff of the Authority and the Area Boards. At its recent meeting, the National Joint Managerial and Higher Executive Grades Committee approved the adoption of the following salaried scales for application to posts (below the level of sub-area manager and chief generation engineer) at Central Authority headquarters, Generating Divisions, Area Board headquarters, sub-areas and districts. These are back dated to operate from April 1, 1952.

Scale 1	£1,150 x £50 to £1,300
Scale 2	£1,300 x £50 to £1,450
Scale 3	£1,450 x £50 to £1,600
Scale 4	£1,600 x £50 to £1,750
Scale 5	£1,750 x £50 to £1,900
Scale 6	£1,900 x £50 to £2,050
Scale 7	£2,050 x £50 to £2,200

There is an additional £50 per annum London "Weighting" where applicable.

The three organisations involved in the negotiations with the B.E.A. are the A.M.E.E., E.P.E.A., and N.A.L.G.O.

The Electricity Boards having submitted detailed proposals for the application of these salary scales, agreement was reached on the scale application to present holders of the posts subject to the outcome of further consideration in certain cases, we understand.

It is anticipated that salary adjustments necessitated by the adoption of the new salary scales will be made next month.

U.S. Exhibitions of Home Appliances

THE two National Housewares and Home Appliances Exhibitions held each year in America are probably among the most popular shows held in that country. Certainly the demand for space bears out that contention, for applications were so numerous in 1953 that a new exhibition, the Independent Housewares Exhibition, was held to cater for those exhibitors who failed to obtain space at the original shows. The 1954 exhibitions will be held in Chicago between January 14 and 21, and in Atlantic City from July 12 to 16.

Over 500 exhibitors took part in the Chicago show in 1953, displaying all types of merchandise suitable for the home. The two groups which cater specifically for the electrical industry fall under the headings, Electrical Appliances and Home Laundry Equipment. We are informed that direct participation by British manufacturers is not advisable, but that the exhibitions can be recommended to firms having agents or distributors in the U.S.. The organiser is Mr. A. W. Buddenberg, National Housewares Manufacturers Assoc., 1140 Merchandise Mart, Chicago 54.

Additional Space Available at 1954 B.E.P.C. Exhibition

THERE is some additional space available in the exhibition marquee at Eastbourne during the British Electrical Power Convention next year. The exhibition committee announces that a limited amount of space is being offered to non-member firms—those that are not identified with any Convention Member Association. Applications should reach Mr. V. W. Dale, general manager and secretary before January 15. The Convention takes place between June 14 and 19.

New Company will make Switchplugs

BECAUSE of increased demand for electrical accessories Bill Switchgear, Ltd., have formed a new company, to be called Bill Switchplugs, Ltd. This was announced by the parent company last week. The new firm will operate from an independent factory at Victoria Rd., Aston, Birmingham. The sales organisation will continue to be handled by Bill Switchgear Ltd.

The First Half-Century

In our electrobubbling notes will be found a paragraph on the cost of keeping a car under the new Act for the discouragement of trade passed by the wisdom of our legislators. Briefly, a car costs £3 7s. a year for licences and registration, besides another pound by way of entrance fee for the privilege of paying. The harmless necessary motor bike is also to cost a pound a year with an initial 5s. extra, a pretty heavy tax in proportion to the cost of the article. What with this and the certainty of being fined, however careful one may be to obey the law, prudent people will probably wait till the legislature comes to its senses.—*From our issue of December 31, 1903.*

First "School" on Rural Electrification

AN innovation in the electrical industry is the arrangement of the first "school" on rural electrification by E.D.A. It is to be held between January 4 and 6 at Nottingham University's School of Agriculture, Sutton Bonnington. The course arises from the interest being shown at present in rural development and the Government's decision to authorise Boards to increase capital expenditure. Members of the staff of all the Electricity Boards (except London) and of the N. Ireland Board, and Eire Board, will be attending. In fact, so great has been the response that delegations have had to be restricted.

The full programme over three days includes a total of nine papers on the various aspects of this subject. Mr. V. W. Dale will open proceedings, and among other speakers will be Messrs. C. R. King, C. A. Cameron-Brown, E. C. Claydon, M. M. Harvey and J. T. Taylor.

U.S. Tour to publicise Scottish Exhibition

JUST returned from a five-week tour of the U.S. and Canada is a delegation from the Scottish Council (Development and Industry) which has been publicising next year's Scottish Industries Exhibition. The party travelled more than 1,500 miles, and are confident that results will flow from the tour in excess of their original expectations. Main object of the mission was to stimulate interest in the forthcoming exhibition, and particularly to enlist the support of consumer goods buyers, manufacturers who purchased raw materials for their own products, and users of capital equipment.

The team also gained a deal of information in selling techniques in the North American market. Quality, they found, was still this country's best selling asset; and in this connection it was suggested that purchase tax, by fostering the manufacture of cheaper goods in Britain, was having an adverse effect. Packaging, too, was a subject emphasised by members of the delegation on their return.

The Scottish Industries Exhibition is to be held at Kelvin Hall, Glasgow, next September.

TRADE MISSION TO MIDDLE EAST BACK

THE British trade mission, which, as reported in our November 19 issue, undertook a five-week tour of the Middle East, returned to London just prior to Christmas. The team, headed by Sir Edward Benthall, visited Baghdad, Kuwait, Damascus, Beirut and Jedda, in the course of their tour. Main impression brought back appears to be that quality alone in products will not keep our footing in this useful market, price is the main concern. British manufacturers were tending to lose business because other countries could produce goods more cheaply. The visit was said to be most profitable. Interest in the declining prestige of Britain in the Middle East has been reawakened. The electrical industry was represented by Mr. D. Maxwell Buist, export director of BEAMA.

Amenities in Our National Parks

AT 30th September there were six National Parks in being, and the establishment of three others was under discussion. Some of the problems faced by electricity boards in these special areas of "natural beauty" and "opportunity for open-air recreation" (to quote the 1949 Act) are underlined in the Fourth Report of the National Parks Commission, which covers the year up to that date.

The long discussions about the route of the 275 kV line from Newcastle to Carlisle, which runs near a prospective National Park, provide an outstanding example of the problems that arise. Conflicting views were expressed by the Commission and the National Farmers' Union and for the third year running discussions continued; this on a link in the transmission system which is universally agreed to be of first importance.

It is noticeable from other cases noted in this report, that the B.E.A. and the area boards are doing their best to meet the recommendations of the amenity conscious commissioners. Reporting a proposed 132 kV line route near the Brecon Beacons, which is another potential National Park, the Commission notes agreement to change the route, and acknowledges that its thanks are due to the B.E.A. for this. Referring to a Merseyside and North Wales E.B. line through a Welsh pass, when the proposed route was changed "although there were technical difficulties," the Commission "desire to thank the Electricity Board for their ready co-operation."

Not all the comments in the report are so welcome, but those quoted do emphasise the great trouble that is taken to meet all manner of "amenities" objections.

E.I.B.A. Annual Meetings

OFFICERS for 1954 were elected at the annual meeting of the E.I.B.A.'s Birmingham branch, earlier this month. Mr. R. L. Batley, Div. Controller of B.E.A., was elected president; Mr. J. M. Surrall, chairman; Mr. H. J. Bick, hon. treasurer; and Mr. L. Wall, hon. secretary. About 100 persons were present at the preceding luncheon. The branch's next social event will be the annual dance on February 12 which will take place at the T.I. Social Club, Oldbury, nr. Birmingham.

We hear that the annual general meeting of the Northern Counties area of E.I.B.A. will take place on January 14, at 3 p.m. Venue will be Carliol House, Newcastle. Chairman is Mr. W. R. Gledson.

N.W. Board connects 200,000th Consumer

AN important little ceremony took place in the living room of a new house in Swalecliffe Ave., Baguley, last week. The Lord Mayor of Manchester was present to fit the fuse, which connected up the N. Western Electricity Board's 200,000th new consumer since vesting day. To mark the occasion, the house's occupants were presented with an electric kettle and a pressure cooker by the Board's chairman, Sir Joseph Hallsworth.

Sir Joseph commented that his Board had managed to save hundreds of thousands of pounds by intensive research and the application of new techniques to new housing installations. As a result their capital allocation had gone much further. An indication of work done was given by the fact that capital expenditure in the Area on new mains and services since April 1948, was about £13½ million.

Sir Joseph also welcomed opportunities offered by the electrical industry which would help to solve the problem of atmospheric pollution.

A statistically-minded person has worked out that the connection of 200,000 consumers since April 1, 1948, is the equivalent of connecting four new consumers every working hours of every working day.

OFFICIAL PUBLICATIONS

PUBLIC BOARDS: List of members of public boards with salaries, etc. H.M.S.O., 9d.

BAKING INDUSTRY (Hours of Work) House of Commons Bill 51. H.M.S.O., 6d.

BRITISH STANDARD Supplement No. 3 (1953) to B.S. 530: 1948. Graphical symbols for telecommunications.

Board's Sports Club will not pay Rates

THE decision of the local valuation panel concerning the question of whether or not rates should be paid for premises occupied by the E. Midlands Electricity Board's social and sports club in Nottingham was announced earlier this month. The club will in future be excused payment of rates. The Electricity Board had appealed to the panel, claiming that the £11 million or more paid each year by the B.E.A. in lieu of rates, should exempt the club. Nottingham, like all other local authorities received their share of the B.E.A.'s contribution, the Board maintained. The appeal was opposed by the local council.

First Award of Naval Electrical Trophy

AN efficiency trophy was inaugurated about a year ago by H.M.S. *Ariel* for annual competition among the five R.N.V.R. Air Divisions. This trophy has been won for the first time by the electrical section of the Northern Air Division operating at R.N.A.S. Stretton, near Warrington. The award will be presented on January 31.

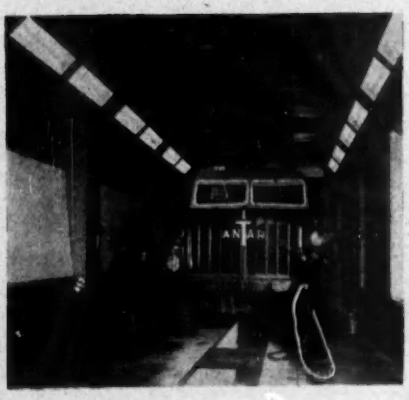
The winning section is under the command of Lt. Cdr. (L.) G. Jones, R.N.V.R., who is a lecturer in electrical engineering at the Old Swan, Liverpool, Technical College. He and his ratings have put in a total of 208 "drills," or attendances at lectures and practical maintenance work, at weekends and during the annual 14 days continuous training. Next year, their annual training will be done in Malta.

This story may be of particular interest to young men yet to do their National Service. It affords a means of avoiding a two years' break in electrical studies.

Spray Painting Booth for Large Vehicles

A NEW spray painting department is now in operation at the works of Transport Equipment (Thornycroft) Ltd., Basingstoke, capable of handling large vehicles. The equipment, designed and installed by Modern-air (Processes) Ltd., consists of a spray booth some 45 ft long, 15 ft wide and 13½ ft high, with a make-up air supply plant and separate space heating plant. The booth incorporates six wet type paint scrubber units each having a water curtain cascading over vitreous enamel pace panels, behind which are the paint scrubbing units. A thermostatically controlled auxiliary make-up plant, with the space heating plant maintains a temperature of 60° F.

This booth is also provided with a pit for under chassis work which is fitted with six flameproof fluorescent lighting fittings supplied by Edison Swan Electric Co. Ltd. The same company also provided 12 industrial trough fluorescent lighting reflectors fitted behind glazed panels for general lighting. All motors and lighting are flameproof.



Flameproof fluorescent fittings employed for general lighting and pit illumination in the new paint-spraying booth of Transport Equipment (Thornycroft) Ltd. They were supplied by Edison Swan Electric Co. Ltd.

Radio and TV Sales Continue to Rise

RADIO and television as a means of entertainment are proving more and more popular as the months pass—not perhaps surprising, but the degree of popularity appears infinitesimal if the perpetual increase in sales is to be the yardstick. Figures released by the R.T.R.A. just before Christmas show that radio sales reached the highest recorded so far this year. Average number of sets sold per shop was 10·01, which compared with 8·41 in the previous month, and 8·03 in October 1952.

Sales of TV sets were almost as remarkable. In the month under review 15·27 sets were sold (highest since the coronation figure of 18·74), compared with 12·12 in September and 12·32 in October last year.

Training of Board's Commercial Staff

COMPREHENSIVE training schemes for their commercial staff is the continued policy of the S.E. Scotland Electricity Board. We hear that two further successful five-day training courses for sales representatives, wiring foremen and installation inspectors have just been completed. Courses have already been held for the benefit of district commercial assistants, demonstrators and service centre assistants, and the need to keep the whole of the Board's commercial staff abreast of latest developments appears to have been fulfilled.

Training in Industry

"EDUCATION and Training in Industry" is the title of the latest course to be arranged by the Institute of Personnel Management between January 31 and February 5. Later courses yet to be completed include those on Retail Distribution in February, Welfare in March, Wage Administration in May, and Office Staff Management in June.

A close-up of Mr. Harben during one of his demonstrations. With him is a "volunteer" assistant, and he is using a Jackson "Two-Ninety" cooker

Two Courses in London

TWO courses arranged by the Dept. of Electrical Engineering and Applied Physics of S.E. London Technical College, have been announced. Both comprise six lectures. The first begins on January 26 and will be on "Electronic Instruments." The second opens on March 9 and will be on "Automatic Process Control."

Cookery Demonstrations Increasingly Popular

QUITE frequently in these columns we have reported the cookery demonstrations staged by various Electricity Boards, and it is increasingly obvious that these "shows" have become more and more popular as the months pass. Principal actor and demonstrator has invariably been Mr. Philip Harben whose TV fame has probably been the crowd-drawing feature. Bearing in mind that these Harben presentations only began this year, the Boards have done a great deal to promote interest in electric cooking.

To date, we estimate that well over 20,000 people have attended demonstrations in 16 different towns throughout the country. The last incidentally was staged by the S. Wales Board in Cardiff on December 9. At one function in Plymouth not long ago Mr. Harben agreed to give three performances in a day to overcome difficulties of booking halls. We understand Mr. Harben has four bookings for January and February next year.

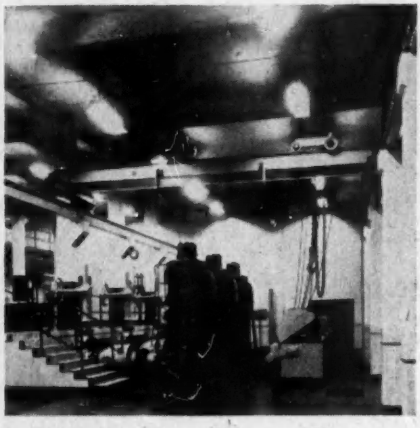
COMPOSITOR'S DEATH DUE TO FAULTY WIRING

AT Brentwood court recently, the Brentwood Gazette Ltd. were fined £50 with 2s. 6d. costs for failing to comply with the Factories Act, following the electrocution of a 27-years-old compositor. Stating the case against the firm, the district Inspector of Factories said that as occupiers of the factory, the Brentwood Gazette were bound to comply with the Factories Act. He said the compositor was using a 240 V a.c. lamp which should have been earthed. This illuminated the keyboard of the typesetting machine and in its original position was correctly earthed; but it was also used as an inspection lamp and was not earthed when lifted clear. The inspector also asserted that the flex was defective, insulation damaged, and the live conductor exposed.

The Inspector went on to say that the defendants alleged that the Eastern Electricity Board was to blame as they installed the lamp. Nevertheless, he said, prime responsibility rested with the defendants. He added that as the lamp was connected by a two-core cable it was obviously not earthed.

Mr. J. May, for the Brentwood Gazette, maintained the fitting was never earthed at all; that the Board was responsible for any negligence on the part of their electrician; and that they were the guilty party. His clients were perfectly entitled to accept that the Board had done their work properly.

For the Board, Mr. Griffiths said it was for the Gazette to notice that. something was wrong. He had pleaded not guilty to the Gazette's information summons. The Brentwood Gazette also pleaded not guilty.



Main pumping units and relative starting mechanism illuminated by 5ft twin fluorescent fittings and lamps. There are three vertical-spindle borehole pumps and space for three more

Lighting at Water Pumping Works

AS Coventry expanded industrially one of the major problems which faced the civic authorities was an adequate supply of water. The difficulty has been solved, partially at least, by the "import" of some 10 million gallons of water per day from the River Severn.

Electrical services at the Strensham Treatment Works —just a part of the overall project—included the laying of power cables and associated equipment, and also a good installation of interior and exterior lighting. Supply of equipment for the works was by Siemens Electric Lamps and Supplies Ltd. Various parts of the works demanded the use of a variety of fittings. Main pumping units are illuminated by 5 ft twin fluorescent lamps and fittings, and the control platform by 5 ft single and double fluorescent units. Complete interior installation involved 70 5 ft single fluorescent fittings, 18 double fittings and about 110 fluorescent tubes. Outside, the approaches were illuminated by 250 W h.p. mercury vapour lamps on concrete columns. Contractors for this scheme were Beaven and Sons Ltd. of Gloucester.

Union Protest

HASLINGDEN Trades Council has again complained to the Corporation concerning electrical repairs in council houses carried out by workmen in the borough's street lighting department. Mr. H. Heyworth of the Rossendale branch of E.T.U. stated at a recent meeting that work was still being done by what his branch considered as unskilled or semi-skilled labour.

City and Guilds New Insignia Award

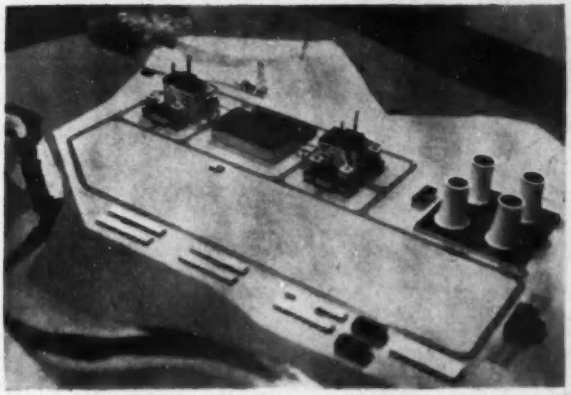
ALTHOUGH the first list of recipients of the City and Guilds of London Institute's Insignia Award in Technology is not ready to be issued at this early stage, we learn that theses are now being received and considered, and that there is every indication that the wide range of topics and standard achieved offer great possibilities as contributions to technological practice and discussion. The Award was established about a year ago to provide a high qualification for those in industry whose initial training was based on practical experience combined with theoretical study. Candidates are considered in five groups in the chemical, constructional, electrical, mechanical and textile industries. A scheme is being considered whereby a precis of theses by successful candidates may be made available to all interested. Details available from the Institute at 31 Brechin Place, S.W.7.

Your Christmas Greetings Heartily Acknowledged

WE take this opportunity of acknowledging the innumerable good wishes which have been extended to us during this festive season. We have been overwhelmed during the past few weeks by these greetings which have reached us, in many instances, in the form of calendars and the like. It is very noticeable that the design of many calendars is retained from year to year, and the new "edition" is invariably awaited with interest. Thus, the D.P. Battery Co. Ltd. always feature a Derbyshire scene, which this year is the extremely attractive view of the River Wye in Chee Dale. Twelve more wonderful views of the British countryside have been chosen by C. A. Parsons and Co. Ltd. in their calendar annually entitled "Our Heritage."

Photographs of babies this year replace the modes of transport illustrated during 1953 by Chloride Batteries Ltd.; the state coach and coronation procession is the most appropriate London scene chosen by the London Electric Wire Co. and Smiths Ltd.; and the Liverpool scene chosen by Liverpool Electric Cable Co. is the famous Speke Hall. A journey through Belgium depicted by 12 colour plates of geographical and historical interest is the feature of the calendar of Ateliers de Constructions Electriques de Charleroi.

Attractive pictures and photographs also enhance calendars produced by Scottish Cables Ltd.; Fraser and Chalmers Engineering Works (G.E.C.); Courtney, Pope (Electrical) Ltd.; the Lindley Thompson Transformer and Service Co. Ltd.; and the British Vacuum Cleaner and Engineering Co. Ltd. We also gratefully acknowledge calendars from Stewarts and Lloyds Ltd.; Permali Ltd.; and from Monsanto Chemicals Ltd.



An "aerial view" of a model of the new atomic power station being built at Calder Hall, Cumberland. The turbine house may be seen in the centre with its administrative control and workshop block. On each side are the two reactors around which are the four vertical boilers. Cooling towers are on the right. Taylor Woodrow Construction Ltd. are the building and civil engineering contractors for the thermal reactor

E.D.A.'s Space Trip

THE last word in space travel has been prepared by the E.D.A. for the Schoolboys Own Exhibition which opens at the Horticultural Hall, Westminster, today (Thursday). The journey into space is part of a new competition, instigated by the Association. Dressed in cosmic ray suits, the boys will travel through time and space, beginning in the prehistoric age and continuing into the coming electronic age. Accent will, of course, be on the development of electricity. Among the phases which the boys will pass through is the Time/Sound Lock where spiralling blue light tends to produce giddiness and weird noises. Objects and rules of the competition are explained *en route*.

NEWS IN BRIEF

All control on the acquisition, disposal, treatment, use and consumption of virgin magnesium and alloys ceases as from tomorrow (Friday).

For the first time apprentices in the electrical contracting industry will this year receive prizes awarded by the Building Apprenticeship and Training Council for outstanding work. Thirty boys will receive a total of £60.

Transformers (Watford) Ltd. have gained the contract for supply of station and unit transformers for Salisbury (S. Rhodesia) power station No. 3.

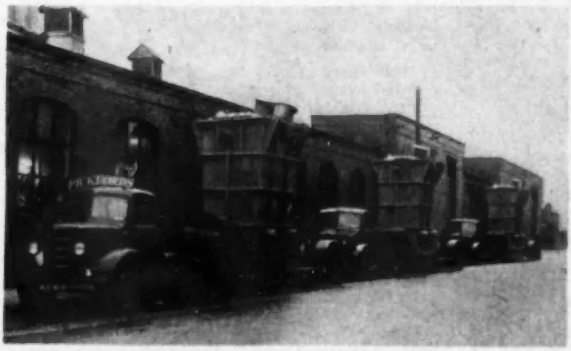
Arrow Electric Switches, Ltd., have recently held an exhibition of motor control gear in Glasgow. This was one of a series of displays being arranged throughout the country.

In the caption associated with the night photograph of an office building which appeared in our December 10 issue, it was implied that the electrical installation had been planned by Ekco Ensign engineers. In fact it was planned by the technical division of the engineering dept. of Unilever Ltd.

Appeal for Funds

PRESIDENT of the I.E.E., Mr. H. Bishop, is appealing to members for contributions to the Institution's Benevolent Fund and Homes Fund. He hopes the generosity of subscribers will this year bridge the gap between the sums paid out and those received. Last year, he points out, the Fund paid out £280 more than it received in donations. Mr. Bishop expresses some disappointment in the fact that the average contribution per member is only 6s. 4d. As regards the Homes Fund, he states that to complete the development of The Chesters estate, some £35,000 is still needed.

Coincidentally, a letter reached us recently from the N. Western Centre expressing grave concern at the lack of support which is being given to the Benevolent Fund. No more than 30% of members contribute, the letter explains.



More electrical equipment earning dollars. This group of three 66,000/24,000 V, 3,333 kVA, 60 c/s, single-phase transformers, forming a three-phase bank, leaves the Royston works of the Denis Ferranti Co. for shipment to Canada

Electric Supply News . . .

Bridlington

An 11 kV cable which the Yorkshire Electricity Board has proposed to erect at Flamborough Head is to be placed underground following objection by the East Riding County Council. This information was given to Bridlington Rural Council recently when the latter agreed to the erection of overhead lines to 21 farms and three cottages in the Carnaby, Burton Agnes, Ulsome, Barmston and Skipsea area.

Eire

During further evidence at the inquiry into the Bann proposed hydro-electric scheme, Mr. W. J. M. Menzies, fishery adviser to the Ministry of Commerce, maintained that the change in the river following the drainage scheme had not affected the salmon industry. He saw no reason for thinking that if the hydro-electric scheme was carried out it would have a destructive effect on the salmon fishery. Mr. C. A. Nicholson, speaking for the owners of the fishing rights, sought to establish that as a result of the drainage scheme carried out some years ago, the average catch of salmon had dropped from 115,000 lb to 77,000 lb per annum.

Fleetwood

Local inshore fishermen have apparently become perturbed at a possible threat to their livelihood as the result of the construction of the B.E.A.'s new power station. At the recent council meeting, Alderman C. Saer made an unsuccessful attempt to refer back a resolution that cooling water from the station now under construction should not be pumped on to the surrounding marshland. He said that the inshore men were concerned that the alternative, of pumping the water into the River Wyre—might destroy fish. One member doubted if there were now any fish in the river. Another pointed out that the B.E.A. had wanted to discharge the water on to the marshland, but the Council had paid much money for the land. If they allowed the B.E.A. to pump water on it, how could they reclaim it in the near future for tipping, he asked.

Gloucestershire

The Severn Wild Fowl Trust, one of the world's largest bird research stations situated on the Severn Estuary at Slimbridge, has now been connected to the Midlands Electricity Board's mains. An 11 kV overhead line has been taken to Slimbridge, and services provided to the Trust's premises, including the home of Mr. Peter Scott, founder and honorary director of the Trust, who believes that electricity can contribute considerably to the Trust's work of preserving wildfowl and collecting information about them. In the past, investigation of the causes of death of wild birds has been handicapped by lack of refrigeration plant in which to store dead birds pending post-mortem examination and many other pathological and bacteriological investigations. Now the necessary refrigerators can be installed. Another contemplated use of electricity relates to the Trust's desire to add to its world-famous collection of 140 different kinds of swans, geese and duck, specimens of the Harlequin Duck from the rivers of Iceland, the Mountain Duck from New Zealand, and the Torrent Duck which lives in the turbulent mountain streams of the Andes in South America. Because of the flat terrain of the Severn Estuary, it has not been possible to create the conditions needed. It is hoped now to make a pump-operated artificial waterfall to provide a home for Harlequins, Mountain Ducks, Torrent Ducks, and perhaps also the rare Salvadori's Duck from the highlands of New Guinea. Electric incubators and brooders may help the Trust to improve on its remarkable achievements in the breeding of rare waterfowl. One immediate aim will be to persuade the Brent Goose to nest. This goose, never yet bred successfully in captivity, normally broods during the long daylight hours of the Arctic summer. With electric lighting to provide such a summer artificially it may be possible to induce it to breed in England.

Hebrides

The island of Bernera in the Hebrides was given its first supply of current from the North of Scotland Hydro Electric Board recently. At the inauguration ceremony, which was performed by Councillor J. M. Macdonald, Mr. Alexander Brodie, representing Kennedy & Donkin, the consulting engineers on the scheme, said that one of the greatest difficulties in taking power to Bernera had been the island's almost complete lack of roads.

LIGHTING SCHEMES

Brampton (Cumberland).—The Parish Council has accepted the Lighting Committee's recommendation to light the town by electricity at a cost of about £3,500.

Buxton.—T.C. has approved the second phase of the street lighting conversion scheme for the borough, at a cost of £4,000.

Dudley.—The whole of the town's street lighting is under revision. It is hoped to convert gas lighting to electricity.

Gt. Yarmouth.—T.C. has approved in principle a scheme for decorative illuminations next season for the south end of Wellington Pier Gardens. The Corporation is to prepare the site and Franco Signs, Ltd., are to provide and erect set pieces valued £5,000, half of this cost being borne by the Corporation. Receipts after deducting maintenance and running expenses will be divided equally between the Corporation and Franco Signs, except for 20%, which will be held by the Borough Treasurer in a joint account as a renewals and depreciation fund.

Company Activities . . .

Associated Engineering Holdings

With a final dividend of 12½% the total distribution for the year ended September 30 last is 17½%, which is the same as for the previous year. The group profit, before taxation, is £1,265,965 —some £321,741 lower than for the preceding period. The net profit amounts to £367,726 *(£438,378)*.

British Electric Resistance Co.

It is proposed to increase the authorised and issued share capital by £50,000 in order to bring the nominal value of the issued capital more nearly into line with the true value of the assets. It is thus intended to give a free bonus issue of save 500,000 Ordinary 2s. shares, to rank *pari passu* with existing shares. This bonus issue should not be taken to indicate that the directors envisage any change in the total annual dividend distribution, it is emphasised. The demand for the company's resistance products was maintained throughout the year, Mr. H. Paulhuhne, the chairman, states, and total sales were above last year's figures. But the ban on imports by certain countries reduced the exports of the British Power Transformer Co., although the sales to Canada of that subsidiary were higher than for last year.

Jerusalem Electric and P.S. Corpn. Ltd.

This concern's operations in the Israel area for the year ended March 31 last, resulted in a deficit of I£73,841, but there was a welcome surplus from activities in the Jordan area. The directors stress that owing to the devaluation of the Israel pound the figures in the accounts are not strictly comparable with the previous year's figures. In the Israel area of supply, costs of operation continued to rise steeply during the year, and tariffs remained inadequate. Units sold increased by nearly 4½ million units to 32 millions. In the Jordan area, unit sales amounted to 1·39 million units, an increase of over 330,000. There is as yet no development to report in connection with negotiations with the Palestine Electric Corporation Ltd.

Year to Mar. 31	£ Operating Surplus	£ Net Profit	% on Ord. Earn'd	% on Ord. Paid	Ord. Price High	Ord. Price Low
1949	—42,717*	—90,123*	—	—	23/9	11/3
1950	30,555	22,622	—	—	14/9	12/3
1951	116,118	28,387	46	—	13/6	7/6
1952	35,161	1,374	—	—	10/9	7/6
1953	—27,863*	—49,511*	—	—	8/9	5/-

* Loss

Radio Rentals Ltd.

A sharp rise in the group trading profit is recorded in the preliminary statement for the year ended August 31 last. At £536,440 that total is £172,262 higher than for the previous period. There is to be a final Ordinary dividend of 30%, making a total of 40% on the increased capital, which will absorb £49,875. For the previous year, the 35% dividend took £37,833. The profit of the group was struck after allowing all charges, except taxation.

S. Smith and Sons (England) Ltd.

Application has been made to the Treasury for consent to the capitalisation of £1,084,117 of reserves by paying up in full 5,420,585 new 4s. Ordinary shares. These would be issued to Ordinary shareholders in the proportion of three new for every five held.

Solus, Teoranta

This Irish electric lamp making concern reports a net profit of £11,407 for the year ended June 30 last, with a final dividend of 5% and bonus of 2½%, the total distribution for the year is 12½% *(same)*.

Sperryn Ltd.

In view of the keener competition during the early months of the year ended July 31 last, and the fall of prices for both raw materials and finished articles, the results for that period (which we noted on December 3) are extremely satisfactory, Mr. G. Neville Sperryn, the chairman, stated at the meeting a few days ago. He referred to the difficulty in competing in some foreign markets where competitors from certain countries such as Germany and Italy are subsidised or helped by the governments in one way or another.

Stream-line Filters Ltd.

A record turnover was achieved during the year ended December 31, 1952, but to some extent at the expense of shortening the balance of orders in hand, Mr. C. S. Garland, the chairman, states. For 1953 the turnover has been substantially maintained but with some further reduction of the volume of forward orders.

Westinghouse Brake and Signal Co.

With a further increase in the trading profit, it is proposed to raise the dividend to 16% for the year ended September 26 last. The group trading profit, etc., for that period is £1,270,787 compared with £1,187,405 for the previous year. After charging depreciation, taxation, etc., and allocating £17,076 (£13,401) to minority interests, the net profit available to the Westinghouse Brake and Signal Co. is £249,605, as against £256,603 for the previous year.

Dividends Declared

Murex Ltd.—Interim of 6% *(same)* but on increased capital. The directors state that, as foreshadowed last September, the level of activities during the first six months of the current year was below that of recent years, when the demand for the company's products was exceptionally heavy. There are indications, however, of a modest improvement during the past two months.

Waygood-Otis Ltd.—Interim of 40% *(30%)*. Last year a total distribution of 55% was paid.

Commercial Information

CONTRACTS OPEN

HOME

Dates given are the final for receipt of tenders, unless otherwise stated

1 Jan.—Wandsworth B.C. Lamps during year from April 1 next —See Dec. 3 issue.

2 Jan.—Evesham R.D.C. Wiring 20 houses.—See Dec. 24 issue.

2 Jan.—Swansea T.C. Equipment for Technical College.—Advertised in Dec. 10 issue.

4 Jan.—Lancaster T.C. Plant for pumping stations. — See Nov. 4 issue.

4 Jan.—Leyton T.C. Street lighting.—Advertised in Dec. 10 issue.

4 Jan.—Morpeth R.D.C. Wiring in agricultural houses at Netherwritten. See Dec. 24 issue.

5 Jan.—Beverley (Yorks) R.D.C. Installation in 10 houses at Beswick.—See Dec. 17 issue.

5 Jan.—Epping U.D.C. Concrete street lighting columns on Beaconfield estate.—See Dec. 17 issue.

6 Jan.—Rowley Regis T.C. Street lighting on Tividale Hall estate.—See Dec. 10 issue.

6 Jan.—Skelton and Brotton U.D.C. Wiring, etc., in 16 houses on Brotton estate.—Advertised in Dec. 17 issue.

6 Jan.—Wandsworth B.C. Street lighting equipment.—Advertised in Dec. 24 issue.

6 Jan.—Wandsworth B.C. Sodium lamps and jackets.—Advertised in Dec. 24 issue.

7 Jan.—Bridgwater (Som.) T.C. Electrical motors, switchgear, etc., at Ashford waterworks.—See Dec. 17 issue.

7 Jan.—Carlow (Eire). Installation at Carlow Mental Hospital. —See Dec. 10 issue.

7 Jan.—Kidsgrove U.D.C. Electrical installation in 14 bungalows in Hollins Crescent. C. Clarke, architect, Town Hall. Deposit £1 1s.

8 Jan.—Camberwell B.C. Supply of electric lamps for 1 or 3 years from April 1 next. Documents from Engineer and Surveyor, Town Hall, S.E.5.

8 Jan.—Hunstanton U.D.C. Supply and laying of about 320 yd of lighting cable on South Beach. Engineer and Surveyor, Council Offices.

8 Jan.—Winchester T.C. Electrical installation in 58 houses on Weeke Manor estate. City Engineer, Guildhall.

9 Jan.—Bootle T.C. Lamps, cables and other electrical goods for year from April 1 next.—See Dec. 17 issue.

9 Jan.—Dagenham T.C. Lamps, cables, conduits and accessories for year beginning April 1 next. —See Dec. 3 issue.

9 Jan.—Finsbury B.C. Lamps wanted during year ending Mar. 31, 1955.—See Dec. 10 issue.

9 Jan.—Longbenton U.D.C. Electrical installation in conversion schemes at Forest Hall. Work involves 310 houses. A. E. Sweetman, Engineer and Surveyor, Council Offices, Forest Hall, Newcastle-on-Tyne. Deposit £2 2s.

9 Jan.—Romford T.C. Lamps included in list of annual supplies.—See Dec. 3 issue.

9 Jan.—Swansea T.C. Electrical installation in Clase primary school. Applications by above date to Borough Architect, the Guildhall. Deposit £2 —Advertised in this issue.

11 Jan.—Aberdare U.D.C. Lighting equipment at Hirwaun Rd., and Victoria Sq.—Advertised in Dec. 17 issue.

11 Jan.—N. Ireland. Installation at Waveney Hospital, Ballymena.—See Dec. 24 issue.

12 Jan.—Stoke-on-Trent T.C. Supply, erection and wiring of 25 concrete columns with fluorescent lamps and lanterns in Class A at Hanley and Burslem. Documents from City Engineer. Deposit £2 2s.

14 Jan.—Co. Down. Installation in school meals centre at Donaghadee.—See Dec. 24 issue.

15 Jan. — Burntisland T.C. Supply of 30 concrete columns and 30 mercury discharge lanterns and equipment. Burgh Engineer, 41 High St.

15 Jan.—Lerwick (Scotland). Installation in school at Bell's Brae.—See Dec. 10 issue.

15 Jan.—Sheffield T.C. Installation at Manor Community Centre.—See Dec. 24 issue.

16 Jan.—Plymouth T.C. Supply of 1,500 yd of 0·06 sq in. and 5,400 yd of 0·04 sq in. 3-core 11 kV impregnated paper insulated, double steel tape armoured solid type power cables. Details from N. G. Elliot, City Water Engineer, 22 Portland Sq. —Advertised in this issue.

18 Jan.—Angus. Electrical work concerning centralisation of heating and hot water services at Stracathro Hospital, near Brechin. Apply by above date to Regional Engineer, Eastern Hospital Board, 430 Blackness Rd., Dundee.

18 Jan.—Birkenhead T.C. Supply of lamps and cables during year ending Mar. 31, 1955. Transport Manager, Transport Offices, Laird St.

18 Jan.—Eston (Yorks) U.D.C. Supply and erection of 66 concrete columns, 35 cast iron columns, brackets, 100 W, tungsten lamps, time switches, wiring, etc. N. C. Harrison, surveyor, Normanby Rd., South Bank-on-Tees. Deposit £2 2s.

18 Jan.—Market Harborough U.D.C. Overhead lines and underground cable in waterworks extension.—Advertised in Dec. 10 issue.

20 Jan. — Fareham (Hants) U.D.C. Fittings and lamps during 1954-55.—See Dec. 24 issue.

20 Jan. — Lutterworth R.D.C. Wiring, etc., in 100 houses in district. Surveyor, Council Offices, Lutterworth, nr. Rugby.

20 Jan.—N. Ireland. Supply of electric cooker, food trolley and other equipment to N. Antrim Hospital Management Committee. Details from R. Thompson, secretary, Robinson Memorial Hospital, Ballymoney.

22 Jan.—Edinburgh T.C. Installation in 32 houses, and five shops at Canongate.—See Dec. 17 issue.

25 Jan.—St. Neots U.D.C. Vertical unchokeable sewage pumps.—See Dec. 17 issue.

27 Jan.—Stamford (Lincs.) T.C. Street lighting.—See Dec. 10 issue.

29 Jan.—Salford T.C. Thermal storage calorifier, centrifugal boiler feed pump, etc., at Black-

friars Public Baths.—See Dec. 24 issue.

1 Feb.—N. Cotswold (Glos.) R.D.C. Pumps and auxiliary equipment and other works at Moreton-in-Marsh pumping station.—See Dec. 24 issue.

3 Feb.—Donegal. Installation in District Hospital at Dungloe.—See Dec. 24 issue.

5 Mar. — Belfast T.C. Tenders (N.1258) invited for supply, erection, etc. of seven 220,000 lb/hr stoker fired boiler units and other plant for power station West. Merz and McLellan, consulting engineers, Carliol House, Newcastle-on-Tyne. Deposit £5 5s.—Advertised in this issue.

No date stated.—Bathgate T.C. Installation in 100 dwellings on Kirkton and Boghall site.—See Dec. 24 issue.

No date stated.—Stradsett (Norf.). Lighting and heating in St. Mary's Church.—See Dec. 24 issue.

No date stated.—Hertfordshire. Applications invited to be included on list of contractors for electrical work. Clerk of County Council, County Hall, Hertford.

OVERSEAS

*Details of items marked * may be obtained on application to the Board of Trade, Lacon House, Theobalds Road, W.C.1, quoting reference.*

26 Jan.—Egypt. Supply and erection of 11 kV o.h. transmission lines, switching and transformer substations and connected cable system with transformers, switchgear, cables, cable boxes and accessories. Ref.: 30/Elec. and Gas 3/2/596. Documents from Chief Inspecting Engineer, Egyptian Govt., 41 Tothill St., London, S.W.1. Deposit £3 1s. 6d.

26 Jan.—Pakistan. Tenders (Eng-X/28254/53) invited for three 1,500 kW Diesel generating sets with accessories, one water cooler, one water softening plant, an electrically-driven air compressor, and spares. Dept. of Supply and Development, Frere Rd., Karachi. B.o.T. (Ref: ESB 12011/53)*.

27 Jan.—S. Rhodesia. Supply of 4,000 ft of 0·0225 sq in. 2-core 660 V grade-armoured cable, sector-shaped conductors, and of 3,000 ft of 0·04 sq in. 4-core 660 V grade-armoured cable, sector-shaped conductors, for Electricity Dept., Municipality of Umtali. Contract E.55/1953. B.o.T. (Ref.: ESB 11895/53).*

27 Jan.—U.S.A. Supply of two fish channel water supply generators for Dalles Dam power station. (Contract CIVENG 35-026-54-65.) District Engineer, Corps of Engineers, U.S. Army 628, Pittock Block, Portland 5, Oregon. B.o.T. (Ref.: ESB 12245/53)*.

29 Jan.—Tangier. Supply and installation of h.t. and l.t. armoured cable, terminal boxes and other work for transformer station. L'Ingenieur Directeur de la Regie des Services d'Eau et de El Electricite, 4 rue Vermeer, Tangier. B.o.T. (Ref: ESB 11272/53)*.

10 Feb.—New Zealand. Post and Telegraph Dept. invites tenders (P. and T. 150/6677) for supply of some 3,850 lamps and 400 suppressors to various specifications. Director General (Stores Div.), G.P.O., Wellington. B.o.T. (Ref.: ESB 11891/53)*.

16 Mar.—New Zealand. Supply of twelve 3-circuit carrier telephone systems for open-wire lines. Also of 20 portable transmission level measuring sets (decibelmeters); 20 portable variable frequency oscillators; six high-frequency carrier telegraph systems; eight relay and distortion test panels and test oscillator panels for generating telegraph signals; and two separating filter sets. Director-General (Stores Div.), G.P.O., Wellington. Quote P. and T. 150/6670.

CONTRACTS PLACED

Brampton (Cumb) D.C. Electric street lighting in the village, Metropolitan-Vickers Electrical Co. Ltd., £3,500.

Cowdenbeath T.C. Improved lighting along trunk road A.90, General Electric Co., Ltd., £4,531.

Glasgow T.C. Installation of two a.c. six-inch centrifugal pumps at Dalmarnock sewage works, Drysdale and Co., Ltd., £3,845.

London. Electrical installation at Torridon primary school, Lewisham, Thorpe and Thorpe Ltd., £4,030.

Manchester T.C. Electrical work at Moss Nook secondary school, Hartley Electromotives Ltd.

Middlesbrough T.C. Electrical services in relighting of Newport and Corporation Rds., N.E. Electricity Board, £1,140.

Your Queries — Answered

"Tomlinson" 4-gallon wash boilers, makers of? A.B.—F. J. Tomlinson Ltd., Hall Carr Mill, Rawtenstall, Rossendale, Lancs. (25442).

'Montgomery Ward' washing machines, agents for? S.W.—J. Toubkin, Faraday Hse, Todd St., Manchester. (25473)

"Warrenty" blankets, makers of? T.E.—Warrenty Electrical Products Co., 18 Hendale Ave., N.W.4. (25488)

Electric Fence makers noted in the Smithfield Show article which appeared on December 10, addresses of? W.P.—R. J. Fullwood and Bland, 25/35 Bevenden St., N.1.; Maxin Eng., Ltd., Charvil Works, Bath Rd., Twyford, Berks.; G. Brammer, 346 Green Lane, S.E.9; Harvest Saver and Implement Co., Ltd., The Works, Kirby Moorside; Cooper-Stewart Eng. Co., Ltd., Stewart House, Works Rd., Letchworth; Wolseley Sheep Shearing Machine Co., Ltd., Electric Ave., Witton, Birmingham. (25495)

"Astron" combined infra-red and sun tonic fittings, makers of? T.C.—These were supplied by a concern trading under the name Jennings, at Caswell House, London Rd., Hounslow, a firm which can no longer be traced. The Electrical Repairs Co., 93 Park Rd. North, W.3, are prepared to undertake repairs. (25509)

"Nico-Caloray" fires, makers of? D.E.—Nico Light Eng. Co. Ltd., 1 Land St., Croydon, Surrey. (25526)

The above are selected from questions we have answered this week. If you have a query, send it to us.

GAZETTE ANNOUNCEMENTS

COMPANIES ACTS

Bailey and Clapham Ltd. At meeting on Dec. 14 resolution passed for voluntary winding-up. Liquidator appointed is Albert Brighton Kitchen, Old Bank Chambers, Keighley.

Electrical and Sound Services Ltd. Meetings of members and creditors will be held at offices of A. Hawes Richards, Barclay's Bank Chambers, 39 Fleet St., Torquay, on Jan. 25 at 2.30 p.m. and 3 p.m. respectively, to receive liquidator's report.

Madras Electric Tramways (1904) Ltd. Petition for winding-up presented on Dec. 4 and directed to be heard on Jan. 11. Interested persons should contact King and Partridge, Attorneys for Petitioner, Regal House, McLean St., Madras, by Jan. 9.

A. W. Marsh, Ltd. Resolution for voluntary winding-up passed at meeting on Dec. 14. D. Morgan, Inc. Acc., 100 Park St., W.1, has been appointed liquidator.

Edward Wolf and Son Ltd. Resolution for voluntary winding-up passed at meeting on Dec. 7. At subsequent meeting of creditors, N. W. Osborne, C.A., 11-12 Finsbury Sq., E.C.2, was appointed liquidator.

BANKRUPTCY ACTS

Intended Dividends

Canterbury. Leonard F. Kent, radio and electrical engineer of 32 High St., Broadstairs. Last day for receiving proofs, Jan. 9. Trustee is A. M. Lander, Official Receiver, 1 The Parade, Canterbury.

Walsall. Cyril G. Clews, electrical contractor, trading as Clews Electrical Co., at 226 Stafford St., Walsall. Last day for receiving proofs, Jan. 5. Trustee is R. F. Bendall, 126 Colmore Row, Birmingham.

PRICE OF CABLE METALS AND OTHER MATERIALS

(Official prices on Tuesday, Dec. 29)

	£ per ton	Weekly change
COPPER, standard class A (settlement)	234	+2½
" (3 months)	221½	+1½
LEAD, refined pig, min. 99·97% purity (cash)	89½	+¼
" (3 months)	88½	+¼
TIN, refined, min. 99·75% purity (settlement)	650	—
" (3 months)	634	+6½
ALUMINIUM, ingots 99·99·5%	150 0 0	—
ZINC, virgin, min. 98% purity (cash) ...	75	−¼
" (3 months)	73¾	−¼
RUBBER No. 1, RSS. spot (per lb.)	17⅜	+⅛
" c.i.f. basis, ports. Mar. (per lb.)	17½	+⅛
ARMOURING:		
Galv. Steel Wire (0·104 in.)	51 10 0	—
Mild Steel Tape (0·014 in.)	40 0 0	—

NEW COMPANIES

Extracted from the Register issued by Jordan and Sons, Ltd., 116 Chancery Lane, London, W.C.2.

Morrison Y Compania Sociedad Anonima Commercial, Vintry House, Queen Street Place, E.C. Registered in Chile in Feb. 1952. Importers and exporters of machinery, tools, electrical, mechanical and other articles, etc. Cap.: 8,600,000 pesos. Persons authorised to accept service: F. W. Hoare and D. G. Morrison.

Norwest Electrical, Ltd. Electrical engineers and contractors, wireless apparatus manufacturers, etc. Cap.: £1,000. Dirs.: to be appointed by subs. Subs.: Jean Herbert and Claire Moore.

Queensford Equipment Co., Ltd. To enter into agreement with Robert R. C. Barlow, of 369 High Rd., Chiswick, W.4, for purchase of all rights and other assets relating to electric reversing switch known as Boston Reversing Switch and carry on business of electrical, mechanical, power transmission and general engineers, etc. Cap.: £1,000. Dirs.: A. Champion, Cardy Hse., Boxmoor, Herts; and R. R. C. Barlow, 369 High Rd., Chiswick, W.4.

Radio Surplus Disposals, Ltd., 46 Market Place, Reading. Manufacturers of and dealers in domestic, household and general electrical, radio, television and other equipment and appliances, etc. Cap.: £100. Dirs.: to be appointed by subs. Subs.: J. Sheridan, 17 Bankton Rd., Brixton, S.W.2; and J. J. Sayers, 49 Chalsey Rd., Brockley, S.E.4.

Recording Machines, Ltd., 103 Cannon St., E.C.4. Manufacturers of and dealers in radio, wireless, radiograms, television, gramophones and sound reproducing machines of all kinds, etc. Cap. £100. Dirs.: C. A. Ford, Sir Arthur Cunningham Lothian.

F. C. Ward and Son (Electrical), Ltd., 261 King St., Hammersmith, W.6. Contractors, manufacturers and installers of electrical heating, lighting, power, wireless, refrigerating and ventilating systems and equipment, etc. Cap.: £1,000. Dirs.: F. C. Ward, J. F. Ward, and E. G. Utton.

National Industrial Fuel Efficiency Service, Thames House South (Room 1633), Millbank, S.W. Word "Limited" omitted from title by licence of Board of Trade. Income and property of company, whencesoever derived, shall be applied solely towards promotion of its objects. Dirs.: to be appointed by British Productivity Council. Subs.: Sir L. M. Hollinghurst, 12 Newnham Hse, Manor Fields, Putney Hill, S.W.15; Sir E. Herbert, Viyella Hse., Nottingham; G. M. Flather, Standard Steel Works, Tinsley, Sheffield 9; H. F. Jones; J. Tanner; Sir P. Dollar, K.B.; Sir J. Hacking; L. Jenkins; and J. Pode.

TRADE NOTES

Change of Address. The London office of the Electricity Trust of South Australia, has moved from No. 7 to No. 12 Queen Anne's Gate, S.W.1.

Mr. K. A. Spencer, B.Sc.(Tech), A.M.I.Chem.E., A.M.C.T., consulting engineer specialising in anti-corrosion measures, is now operating from new offices at 19 Grosvenor Place, London, S.W.1. Telephone Sloane 4884.

Sales Control. Due to the expansion of the electricity business of the Remote Control Division of Measurement Ltd. at Kennington and the meter business at Tameside Works, it has been decided to direct the combined sales organisations from the Kennington works. As from January 1, 1954, all correspondence concerning Measurement electrical products should be addressed to the firm's Electrical Division at 7-17 Fitzalan Street, Kennington, London S.E.11. Telephone Reliance 2406.

BUSINESS PROSPECTS

HOME

Aberdeen. Schemes in hand for maternity and child welfare clinic to cost about £24,500, and also for library and community centre estimated to cost £15,000. at Northfield. Plans for former have been approved.

Armagh. Approval given for erection of health clinic in Montague St., Tandragee.

Barnsley. Plans approved for Athersley secondary modern school. Estimated cost, £206,039.

Bexhill (Sussex). Architects for R.C. secondary school in Ashdown Rd. are L. O. L. Hannen and J. H. Markham, 7 Victoria St., London S.W.1.

Birmingham. It is proposed to erect maternity and child welfare centre in Benacre St. at estimated cost of £72,262.

Birmingham T.C. Erection of 24 flats at Yardley. H. J. Manzoni, City Engineer and Surveyor, Civic Centre.

Bolton. Establishment of R.C. English Martyrs' school at Townleys, estimated to cost £138,000, has been approved.

Bridgwater (Som.) T.C. Tenders may soon be invited for installation of electricity in 1,132 pre-war council houses.

Carlisle. Plans approved for erection of beer bottling and mineral water factory on Durranhill Industrial estate for Patey and Sons. Architects are Johnston and Wright, 13 Castle St.

Castlereagh (N.I.) R.D.C. Erection of 34 houses at Dundonald. Council Office, 51 Lisburn Rd., Belfast.

Chatham. Admiralty proposes to build total of 210 houses.

Cranbrook (Kent). R.D.C. Next year's building programme comprises 46 houses at Cranbrook, 20 at Benenden, 18 at Goudhurst, 12 at Frittenden and 4 at Sandhurst.

Darwen (Lancs.). T.C It is suggested that 32 flats be built at Lower Wood Bank, 28 in Redvers Rd., and 12 in Snape Street.

Dudley T.C. Revised plans approved for Simms Lane secondary modern school.

Durham T.C. Scheme for 115 houses on Merry Oaks estate, Neville's Cross, has been approved in principle.

Glasgow. J. C. Watt (Meat) Ltd., Avondale Works, are to extend their premises. Architects are Gavin Paterson and Son, 147 West Regent Street.

Halesowen (Worc.). Planning permission granted for erection of factory in Park Lane, for Thomas and Yeomans, Ltd., 76 Attwood St., Lye, Stourbridge.

Harpenden (Herts.). It is proposed to build junior and infants, and secondary schools at Roundwood Park. Estimated costs, £60,749 and £117,900.

Hatfield (Herts.). Junior and infants' school, estimated to cost £57,431, proposed at Redhall.

Hertford. Secondary modern school to be built at Balls Park. Estimated cost, £163.880.

Inverness T.C. Approval given for further 50 houses at Hilton for Scottish Special Housing Association.

Isle of Wight. It is proposed to erect secondary modern school at Upper Ventnor. Cost estimated at £151,936.

Jarrow-on-Tyne T.C. Permission received to build 33 bungalows, 4 shops and 8 maisonnettes in High Street.

Kilmarnock. Dean of Guild Court has approved erection of 114 houses on Onthank estate, and other houses and shops on five sites.

Kirkintilloch T.C. Dean of Guild Court has approved erection of £23,485 fire station.

Langold (Worksop). Harwood Cash and Co., Ltd., of Mansfield to build new branch factory.

London. City of London Real Property Co., Ltd., propose erection of multi-storey office block in Seething Lane.

Luton T.C. £77,088 Austin Rd. junior school has been included in 1953-54 building programme. Sketch plans approved for R.C. school in Gardenia Ave.

North Riding. Turner and Ing, 71 Linthorpe Rd., Middlesbrough, are quantity surveyors for proposed Northallerton county primary school.

Northumberland. Health Committee to spend £6,800 installing radio apparatus in 39 ambulances.

Nottingham. Approval sought for erection of Whitegate infant and junior schools, estimated to cost £95,340, and Deering secondary school, Wilford, £162,146.

Norwich. Fletcher and Son, Ltd., to erect single-storey printing works on Harford industrial estate. Architects are J. Owen Bond and Son, St. Faiths House, Mountergate.

Ossett T.C. Erection of 40 houses on three sites. Borough Surveyor, Town Hall.

Sheffield T.C. Construction of 227 dwellings on Greenhill estate. J. L. Womersley, City Architect, Town Hall.

Southend-on-Sea. Approval granted for erection at airport of £33,500 factory to be leased to Aviation Traders, Ltd.

Stevenage (Herts.). Sketch plans approved for junior and infants school estimated to cost £114,279.

Stocksbridge U.D.C. Erection of 44 flats in Ridal Ave. Council's Surveyor, D. E. Robinson, Town Hall, Stocksbridge, Sheffield.

Surbiton (Surrey). T.C. approved erection of factory and offices off Cox Lane. Matthews and Son, architects, 91 Gower St., London W.C.1.

Wakefield. Construction of secondary bilateral school. City Engineer, Town Hall.

Walton and Weybridge U.D.C. Town Hall and civic centre to be built on site in New Zealand Ave. at estimated cost of £100,000.

West Ham. Approval received for erection of second stage of Portway primary school. Estimated cost £50,981.

Weymouth. T.C Erection of 120 houses in Littlemoor Rd., Preston, approved.

Wortley (Yorks) R.D.C. Erection of 48 flats, 46 houses and 12 bungalows at Chapeltown. Consultants, Husband and Co., 388 Glossop Rd., Sheffield.

OVERSEAS

Canada. E. B. Fielding and Co., 46 Front St. East, Toronto, are seeking small electrical household appliances and power-operated hand tools made in U.K., for sale on commission basis.

Lebanon. M. Ezzat Jallad and Fils, 32 Rue Patriarche Hoyek, Beirut, wish to receive offers for two steam-turbine generating plants of 3,500 to 4,000 kW each, or four diesel electric sets capable of producing total of 7,000 to 8,000 kW. Supply is 5,500 V, 3-phase, 50 c/s. Required by Govt. for supplying power to Beirut.

MEETINGS TO NOTE

FRIDAY, JAN. 1

I.E.S. (Bath and Bristol).—"Stage Lighting including Latest Developments." L. G. Applebee. At Bristol, 6.15 p.m.

SATURDAY, JAN. 2

BIRMINGHAM ELECTRIC CLUB. Tenth annual children's party at Grand Hotel, 3 p.m.

MONDAY, JAN. 4

N. EASTERN ELECTRIC CLUB. 'X-rays in the Medical World." A. J. Wright.

I.E.E. (Mersey and N. Wales).—"Electronic Telephone Exchanges," T. H. Flowers. Liverpool Royal Instn., Colquitt St., 6.30 p.m.

I.E.E. (S. Midland).—Discussion on "Tech. Education of Non-National Certificate Students." J. Ashmore and D. I. Meyrick. James Watt Memorial Inst., Great Charles St., Birmingham, 6 p.m.

I.E.E. (Ipswich). — "Modern Developments in Atomic Energy." T. E. Allibone. Crown and Anchor Hotel, 6.30 p.m.

I.E.E. (Maidstone).—"Education for Electrical Industry." H. E. Etherington and L. J. N. Kirkby. Sun Hotel, Chatham, 7.30 p.m.

A.S.E.E. (Leeds). — "Lighting." Great Northern Hotel, 7.30 p.m.

A.S.E.E. (N.E. London).—"Flameproof Equipment." H. S. Allpress. Angel Hotel, Ilford, 8 p.m.

A.S.E.E. (Sheffield). — "Electric Lifts and Controls." C. Rhodes. Royal Victoria Station Hotel, 7.30 p.m.

E.P.E.A. (London).—"Removal of Sulphur Oxides from Power Station Flue Gases." R. L. Rees. Caxton Hall, Westminster, 7 p.m.

TUESDAY, JAN. 5

INCORP. PLANT ENGRS. (London).—"Transmission Equipment and Bearings." F. J. Walters. Royal Soc. of Arts, W.C.2, 7 p.m.

INCORP. PLANT ENGRS. (Edinburgh)—"Power Factor Correction." H. Ferguson. 25 Charlotte Sq., 7 p.m.

I.E.E. (London Measurements.)—"Scaling Unit employing Multi-Electrode Cold-Cathode Tubes," and "Sensitive Pulse Trigger Circuit with Stable Threshold," K. Kandiah. Also "Development of Neutron Spectrometer for Intermediate Energies." F. S. Goulding, J. C. Hammerton, M. G. Kelliher, A. W. Merrison, and E. R. Wiblin. Savoy Place, W.C.2, 5.30 p.m.

I.E.E. (N. Midland).—"Voltage Transformers and Current Transformers associated with Switchgear." W. Gray and A. Wright. Elect. Offices, 1 Whitehall Rd., Leeds, 6.30 p.m.

I.E.E. (N. Western).—"Co-ordination of Insulation of High-Voltage Electrical Installations." J. S. Cliff. Engineers' Club, Albert Sq., Manchester, 6.15 p.m.

A.S.E.E. (S.E. London).—"Maintenance Problems." Congregational Church Hall, Court Rd., Eltham, 8 p.m.

A.S.E.E. (W. London).—"Television Studios Planning." H. C. Nichols. Windsor Castle Hotel, King St., Hammersmith, 7.30 p.m.

WEDNESDAY, JAN. 6

I.E.E. (N.W. Radio).—"Simple Connection between Closed-Loop Transient Response and Open-Loop Frequency Response." J. C. West and J. Potts. Engineers' Club, Albert Sq., Manchester, 6.30 p.m.

I.E.E. (Southern).—"Operation of Power Transformers." E. T. Norris. Elect. Board H.Q., Hove, 6.30 p.m.

INSTN. OF MECHANICAL ENGRS.—Discussion on "Future Development of National Certificate and Diploma Courses." Storey's Gate, London, S.W.1, 6.45 p.m.

TELEVISION SOC.—"Marconi Television O.B. Unit." C. Carrington. Film Hse., Wardour St., 6.45 p.m.

BRITISH INSTN. OF RADIO ENGRS. (London).—"Engineering Design of V.H.F. Multi-channel Telephone Equipment." W. T. Brown. School of Hygiene, Keppel St., W.C.1, 6.30 p.m.

I.E.S. (Edinburgh).—"Architect's Approach to Artificial Lighting." R. G. Cox. Manor Club, 12 Rothesay Place, 7 p.m.

I.E.S. (Newcastle).—Twelfth Night Party. Roadway Hse., 8 Oxford St., 6.15 p.m.

I.E.S. (Swansea).—"Flameproof Lighting Equipment for Hazardous Situations." D. A. Strachan. Mirror Hall, Y.M.C.A., 6.30 p.m.

I.E.E. (Tees-side).—"Electrical Hazards and Safety." D. A. Picken. Cleveland Scientific and Tech. Inst., Middlesbrough, 6.30 p.m.

A.S.E.E. (N. London).—"Power Factor Correction." Queens Head, 677 Green Lanes, Harringay, 7.45 p.m.

A.S.E.E. (Preston).—"Miniature Circuit-Breakers." H. W. Wolff. Chamber of Commerce, 49a Fishergate, 7.30 p.m.

THURSDAY, JAN. 7

BRITISH INSTN. OF RADIO ENGRS. (N. Western).—"Manchester University Computor." D. B. G. Edwards. College of Technology Manchester, 7 p.m.

BRITISH INSTN. OF RADIO ENGRS. (Merseyside).—"Interlacing Problems in TV Receivers." Dr. G. N. Patchett. Elect. Offices, Whitechapel, Liverpool, 7 p.m.

I.E.S. (Cardiff).—"Flameproof Lighting Equipment for Hazardous Situations." D. R. Strachan. Elect. Offices, The Hayes, 5.45 p.m.

I.E.S. (Glasgow).—"Architect's Approach to Artificial Lighting." R. G. Cox. 39 Elmbank Crescent, 6.30 p.m.

I.E.S. (Glos. and Cheltenham).—Architects' Night. Cadena Cafe, High St., Cheltenham, 6.30 p.m.

I.E.S. (Nottingham).—"Application of Fluorescent Dimming Circuits." H. H. Ballin. Elect. Offices, Smithy Row, 6 p.m.

I.E.E. (London).—Parsons Memorial Lecture on "Continuity of Electricity Supply." H. Leyburn. Savoy Place, W.C.2, 5.30 p.m.

A.S.E.E. (S. London).—"Water Heating." R. Oldroyd. Cafe Royal, Croydon, 8 p.m.

FRIDAY, JAN. 8

I.E.S. (Birmingham).—Annual dinner at Midland Hotel.

INSTN. OF MECHANICAL ENGRS.—"Experimental Investigation into Effect of Fuel Addition to Intake Air on Performance of Compression Ignition Engine," W. Y. Lyn; "Effect of Auxiliary Fuels on Smoke-limited Power Output of Diesel Engines," L. D. Derry, E. M. Dodds, E. B. Evans, and D. Royle. Storey's Gate, S.W.1, 5.30 p.m.

A.S.E.E. (Liverpool).—"Some Aspects of Motor Control Gear." K. N. Swash. Engineering Soc., 9 The Temple, Dale St., 7.30 p.m.

A.S.E.E. (Stoke and Crewe).—"Industrial Lighting." P. Corry. Copeland Arms Hotel, Stoke, 7.30 p.m.

EXHIBITION DIARY

Hotel, Restaurant and Catering.—Fourth exhibition to be held at Olympia, London, from Jan. 20 to 29.

TRADE MARKS

This information is extracted from the Official Journal by permission of the Controller.

Cygnet. 723,352. Class 9. Wireless, telephonic, television, and telegraphic instruments, etc. Electronics (Westcliffe-on-Sea), Ltd., 14 Wickford Rd., Westcliffe-on-Sea.

Empress. 722,674. Class 9. Television sets, etc. Britamer, Ltd., 11 Southampton Row, W.C.1.

Westmag. 723,250. Class 9. Voltage and electric current regulating apparatus, etc. Westinghouse Brake and Signal Co. Ltd., 82 York Way, King's Cross, N.1.

Jeymer. 720,525. Class 9. Electric kettles, flat irons, coffee percolators, etc. Jack Flack, 9 Jeymer Ave., N.W.2.

Kingfisher. 723,471. Class 9. Echo-sounding apparatus. Rees Mace Marine, Ltd., 11 Hinde St., W.1.

Megadict. 719,892. Class 9. Loudspeaking, telephonic apparatus, etc. Winston Electronics Ltd., 1 Park Rd., Hampton Hill, Hampton, Middx.

Metro-flev. 722,169. Class 9. Instruments and apparatus operated by current control, etc. Metropolitan Eng. Co. Ltd., 47 Whitechapel High St., E.1.

At their new Suffolk factory, Bexford Limited have now begun for the first time in this country, successful quantity production of photographic film base. This dollar-saving project will end the shortage of X-ray film, and will save foreign currency for Britain.

The plant is in continuous operation day and night apart from the two week summer shutdown. This calls for absolutely reliable equipment and dependable electric cabling. The cables total some 150 miles, including underground cable, rubber and asbestos insulated wiring and telephone cable *manufactured and supplied by HENLEYS.*

150 MILES OF HENLEY CABLE IN BRITAIN'S ONLY FILM BASE FACTORY

A view of the Calorifier plant at the Brantham factory of Bexford Ltd. (Bexford Ltd. is an associate of Ilford Ltd. and BX Plastics Ltd.)

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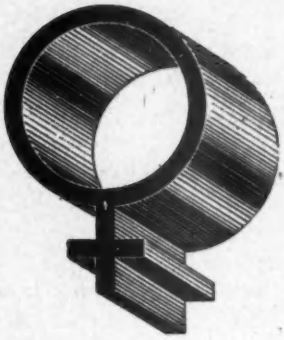

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CLASSIFIED ADVERTISEMENTS

OFFICIAL TENDERS AND APPOINTMENTS

WORK WANTED WANTED · FOR SALE

Those wishing to advertise in these pages should send the text to the Classified Advertisement Dept., Electrical Times, Sardinia House, Sardinia Street, London W.C.2, before 10 a.m. on TUESDAY of week of issue. Official Displayed Advertisements are charged at 42s. per inch, and all other classified advertisements at 3s. per line. Situations Wanted will be published four times for twice the single insertion rate. Fee for Box No. and postage on replies is 2s.

TENDERS INVITED

CITY AND COUNTY BOROUGH OF BELFAST

Electricity Department

STOKER-FIRED BOILER UNITS AND OTHER PLANT
Belfast Municipal Electric Power Station West

TENDERS are re-invited for the Supply, Delivery and Erection of seven 220,000 lb/hr Stoker-fired Boiler Units and other plant.

Form of tender (N. 1258), conditions of contract and specification, in quintuplicate, may be obtained from Messrs. Merz and McLellan, Consulting Engineers, Carliol House, Newcastle-upon-Tyne 1, on payment of a deposit of five guineas, which will be refunded provided a bona fide tender is lodged and not withdrawn. Extra copies of the contract documents may be obtained at one guinea each; this sum will not be returnable. Cheques should be made payable to the Belfast Corporation Electricity Department.

Where a particular make of any equipment is called for in the specification, the tenderer may, if he so desires, offer as an alternative similar equipment of other make approved by the Council after consultation with the Consulting Engineers.

Each tender, in quadruplicate, in sealed envelope marked "Tender for Stoker-fired Boiler Units and Other Plant, Electricity Committee," and endorsed with the name and address of the tenderer, must reach the undersigned not later than 4 p.m. on Friday, March 5, 1954.

An official receipt must be obtained for each tender delivered by hand. Tenders sent by post should be registered.

The lowest or any tender will not necessarily be accepted.

JOHN DUNLOP,
Town Clerk.

City Hall, Belfast.
December, 1953. (G 260)

COUNTY BOROUGH OF SWANSEA

Clase Primary School, Clase, Swansea
TENDERS FOR ELECTRICAL INSTALLATION

FIRMS wishing to tender for the electrical installation at Clase Primary School to be erected at Clase, Swansea, are invited to submit their applications to the Borough Architect, The Guildhall, Swansea, on or before Saturday, January 9, 1954.

Plans, specification and conditions of contract can be obtained on application, and deposit of £2, provided the applicant gives satisfactory evidence of having previously carried out work of a similar character.

The deposit will be refunded after delivery of a bona-fide Tender (which is not subsequently withdrawn) and the return of all documents.

No guarantee is given that the lowest or any other Tender will be accepted.

T. B. BOWEN,
Town Clerk.

The Guildhall,
Swansea.
December 21, 1953. (G 237)

CITY OF PLYMOUTH

WATER DEPARTMENT

TENDERS are invited for the supply and delivery of 1,500 yards of 0·06 sq. in., and 5,400 yards of 0·04 sq. in., three-core, 11 K.V., impregnated paper-insulated, double steel tape armoured, solid type, power cables.

Specification and particulars may be obtained from the undersigned.

Tenders are to be received by the Town Clerk, Pounds House, Peverell, Plymouth, not later than Saturday, January 16, 1954.

The Corporation do not bind themselves to accept the lowest or any tender.

N. G. ELLIOT, M.SC., M.I.C.E.,
City Water Engineer.

22 Portland Square,
Plymouth.
December, 1953. (G 248)

APPOINTMENTS VACANT

Engagement of persons must be made through a Local Labour Office or Scheduled Employment Agency, if the applicant is a man aged 18-64, or a woman aged 18-59, unless the person concerned is excepted or the employment is in a managerial or professional capacity, or is otherwise excepted from the provisions of the Notification of Vacancies Order, 1952.

BRITISH ELECTRICITY AUTHORITY

London Division

BOILER HOUSE SHIFT CHARGE ENGINEER
Barking "A" and "B" Generating Stations

APPLICATIONS are invited for the above superannuable post. Conditions of service in accordance with N.J.B. Agreement, Schedule "A." Qualifications (entitling to Graduate membership of appropriate Institute an advantage. Applicants should have had experience with modern boiler house operation, including Pulverised Fuel. Salary: Class "M," Grade 9, £907 3s. per annum, including London allowance.

Application may be made on form obtainable from Divisional Secretary, B.E.A., London Division, Generation House, Great Portland Street, W.1, and be received within 14 days of this advertisement. (G 260)

SOUTH EASTERN ELECTRICITY BOARD

SENIOR ASSISTANT ENGINEER
(PLANNING AND DEVELOPMENT)
Surrey Sub-Area H.Q.

SALARY: £1,093 to £1,141 p.a. under N.J.B. Agreement Class "F", Grade 4. Superannuable. Applicants should have had extensive responsible experience in distribution design and practice and should preferably be Corporate Members of the I.E.E.

The person appointed will be responsible to the Sub-Area Engineer for the immediate and forward planning of all distribution and transmission networks in the Sub-Area. The Sub-Area supplies a demand of 230 MW with overhead and underground networks up to 33 kV. It has both dense urban and rural characteristics.

Application forms from C. W. Hughes, B.Sc., M.I.E.E., Surrey Manager, SEEBoard, Rough Rew, Horsham Road, Dorking, Surrey, to be returned, giving two referees, by January 11, 1954.

A. L. BURNELL,
Secretary.
(G 231)

RADIO TECHNICIANS

REQUIRED as SIGNALS ASSISTANT INSPECTORS OF POLICE by the GOVERNMENT OF KENYA for one tour of two years, extending to three years by mutual consent and with possibility of permanency. Commencing salary, etc., according to previous experience in scale £786 rising to £1,134 a year. Gratuity (at least £162 after two years' service) payable on satisfactory final completion of service. Outfit allowance £30. Uniform allowance £10 a year. Free passages. Liberal leave on full salary. Candidates aged 20-35 should be at least 5 ft 7 in. without footwear, have normal vision without glasses and be of good education. They should possess a sound knowledge of the installation and maintenance of modern low- and medium-powered V.H.F., static and mobile equipment, H/F transmitters and receivers, petrol generators and diesel electric sets. Previous police experience not necessary.

Apply in writing to the Crown Agents, 4 Millbank, London, S.W.1, stating age, name in block letters, whether married or single, full qualifications and experience and quote M1/30631/EE. (G 239)

NORTH WESTERN ELECTRICITY BOARD

APPOINTMENT OF
THIRD ASSISTANT ENGINEER
(BUILDING CONSTRUCTION)

Sub-Area Mains Engineer's Department, Manchester

THE successful applicant will be required to give general assistance to the Sub-Area Building Construction Engineer in the control and operation of a subsection composed of members of all trades in the building industry. The work involves repair and maintenance of all types of premises within the Sub-Area, the erection of new sub-stations, office blocks, etc.

Applicants must have had a wide experience in the direct control of labour, supervision of contractors, estimating and costing, and practical experience in building design will be considered an advantage.

Salary scale, £808 to £833 p.a., Grade M.10, N.J.B. conditions.

Applications to Sub-Area Secretary, The North Western Electricity Board, Town Hall, Manchester, P.O. Box 493, by January 16, 1954.

APPOINTMENT OF
SENIOR ASSISTANT
(DOMESTIC AND COMMERCIAL DEVELOPMENT)

Sub-Area Consumers' Engineer's Department, Blackburn

Applicants should have had experience in domestic and commercial sales development including publicity and exhibitions.

Salary scale, £640 to £700 p.a., Grade 5, N.J.C. conditions.

APPOINTMENT OF
SECOND ASSISTANT ENGINEER (POWER SALES)

Sub-Area Consumers' Engineer's Department, Blackburn

Applicants must have had experience in the development of industrial sales, with particular reference to the textile and engineering industries, public lighting and d.c. to a.c. changeover investigations, and have obtained the H.N.C. in electrical engineering.

Salary scale, £817 to £852 p.a., Grade J.7, N.J.B. conditions.

Applications for the above appointments to Manager, No. 5 Sub-Area, The North Western Electricity Board, Jubilee Street, Blackburn, by January 16, 1954.

APPOINTMENT OF
GENERAL ASSISTANT ENGINEER (TESTING)

Sub-Area Technical Engineer's Department, Barrow.

The successful applicant will be required to carry out general testing duties in the Class "A" testing station at Barrow-in-Furness and must have had experience in a similar class of station. Preference given to applicants holding at least the O.N.C. (or equivalent) in electrical engineering.

Salary scale: £552 to £573 p.a., Grade J.13, N.J.B. conditions.

Applications to Sub-Area Manager, No. 6 Sub-Area, The North Western Electricity Board, Castle Green, Kendal, by January 16, 1954.

APPOINTMENT OF
FIRST ASSISTANT DISTRICT COMMERCIAL ENGINEER
Stockport District.

Duties will include assisting the District Commercial Engineer as follows:—

Organisation and control of all commercial staff and functions in the district, including the supply of information and advice to consumers on electricity utilisation, tariffs, terms, apparatus and all matters concerning electricity services.

Salary scale: £791 to £816 p.a., Grade F.5, N.J.B. conditions.

Application forms can be obtained from the Sub-Area Manager, No. 7 Sub-Area, The North Western Electricity Board, Sub-Area Headquarters, Chapel Street, Hazel Grove, Cheshire, and must be returned to him by January 16, 1954. (G 253)

GOVERNMENT OF KUWAIT

TWO ASSISTANT ELECTRICAL ENGINEERS required for service with the Government of Kuwait, Persian Gulf, for posting to either Mains or Maintenance Sections. Applicants should hold a B.Sc. or recognised diploma in electrical engineering and should have had sound practical training in a recognised electrical manufacturer's works, or a large industrial concern. Men with practical experience in h.v. and l.v. distribution with supply companies and large industrial installations, would be preferable.

The starting consolidated salary is at the rate of £1,500 to £1,600 according to qualifications and experience. Free furnished quarters and free medical attention are provided, but married accommodation cannot be promised within one year. The first year will be probationary and, if satisfactory, home leave at the rate of two months for each complete year of service will be granted.

Applications, stating age and giving full details of qualifications and experience should, in the first instance, be addressed to the Secretary, Ewbank and Partners Limited, Engineering Consultants, 10/11 Grosvenor Place, London, S.W.1. (G 241)

BRITISH ELECTRICITY AUTHORITY

South Western Division

TECHNICAL STAFF VACANCIES

(a) SECOND ASSISTANT STATION CHEMIST, Plymouth "A" and "B" Generating Stations. N.J.B. Class "H" Grade 11, £607 to £628.

(b) ASSISTANT ENGINEER, Technical Records, Plymouth "B" Power Generating Station. N.J.B. Class "G," Grade 13, £498 to £514.

(c) SHIFT CHARGE ENGINEER, Bath Generating Station. N.J.B. Class "D," Grade 7, £633 to £643. Superannuation scheme.

For (a), applicants should have had practical experience in the analysis of coal, water, oil, etc., for generating stations. Preference given to candidates possessing H.N.C. in chemistry or equivalent. Successful applicant will be required to carry out routine chemistry duties mainly of an analytical nature under the supervision of the Station Chemist.

The duties for (b) will consist mainly of the compilation of technical records and statistics. The possession of a technical qualification is desirable.

For (c) candidates should have had considerable generating station experience. Graduate or Corporate Membership of a recognised engineering institution or equivalent desirable.

Applications on Form A.E.6/ACT obtainable from the Divisional Secretary, 26 Oakfield Road, Bristol 8, should be completed and returned by January 16, 1954. (G 251)

KENT COUNTY COUNCIL

APPLICATIONS are invited for the appointment in the Buildings Department of an ENGINEERING INSPECTOR in A.P.T. Grade V (a) (£625 to £685).

Applicants must have had good practical experience in the design and installation of equipment in one or more of the following, viz. (a) electrical installations for buildings; (b) low-pressure hot water heating and domestic hot and cold water systems; (c) steam services associated with heating and cooking installations.

Preference will be given to members of the Institution of Heating and Ventilating Engineers or the Institution of Electrical Engineers.

Applications, on forms obtainable from the County Architect, Springfield, Maidstone, must be delivered to him within fourteen days of the appearance of this advertisement.

W. L. PLATTS,
Clerk of the County Council.

County Hall,
Maidstone.
December 21, 1953. (G 252)

BRITISH ELECTRICITY AUTHORITY

North Western Division

VACANCY No. 285/53. SHIFT CHARGE ENGINEER, Barrow Generating Station. Salary £633-£643 (D.7).

Vacancy No. 284/53. DEPUTY POWER STATION SUPERINTENDENT at Kearsley Generating Station, near Manchester. Salary £1,182-£1,233 (K.3). Applicants should be fully qualified engineers with experience in the management of a large modern steam power station. An appreciation of modern concepts of administration, financial control and employee relations is desirable.

Applications to Establishments Officer, British Electricity House, 825 Wilmslow Road, Manchester 20, before January 9. Quote Vacancy No. (G 238)

SOUTHERN ELECTRICITY BOARD

SUB-AREA FIELD ENGINEER (CONSTRUCTION)

NORTH SUB-SECTION, covering the Oxford District of No. 2 (Newbury) Sub-Area. N.J.B. Class "L," Grade 13 (£616 to £646 per annum) N.J.B. conditions of service.

The duties of the post will be to carry out the installation and erection of plant, equipment and overhead lines, the laying of mains and other constructional work by direct labour and/or contract chiefly on distribution systems up to and including 33,000 V.

The successful candidate will be required to contribute to the B.E.A. and Area Boards' Superannuation Scheme, if eligible.

Applications on forms obtainable from the Sub-Area Secretary, 7 Oxford Road, Newbury, and returned to him, in envelopes suitably endorsed, not later than January 11, 1954. (G 250)

LONDON ELECTRICITY BOARD

FOREMAN FITTER (ELECTRICAL)

APPLICATIONS are invited for the above position in the Construction Branch of the Southern Sub-Area at Camberwell, S.E.5. Applicants must be experienced in the overhaul and repair of transformers.

Rates of pay and conditions of employment in accordance with Schedule "E" of N.J.I.C. Agreement, Grade 3, £490 p.a. plus £35 London Allowance.

Application forms from Secretary, 46 New Broad Street, E.C.2. Please enclose addressed envelope and quote ref. M/2616/T on envelope and all correspondence. (G 254)

BRITISH ELECTRICITY AUTHORITY

East Midlands Division

APPLICATIONS are invited for the following positions within the Division.

CIVIL ENGINEERING DRAUGHTSMEN
Construction Department. Vacancy No. 22/53
Candidates should have experience in design and detail of reinforced concrete structures, piled and slab foundations for heavy plant, culverts, cable subways, etc., for general building construction drainage and sanitation schemes, associated with official and administrative buildings.
The salary will be in accordance with Grade 8 (£587-£671 per annum) or Grade 6 (£433-£567 per annum) of Schedule "D" of the National Joint Board Agreement.

ENGINEERING DRAUGHTSMEN (MECHANICAL)
Construction Department. Vacancy No. 44/53
Senior Draughtsmen are required in the Mechanical Section of the Construction Department at North Wilford Power Station. Candidates should have experience in one or more of the following:
(i) Design and layout of Power Station equipment, including turbo-alternators, boiler plant, coal and ash plant, and general station auxiliaries.
(ii) H.P. and l.p. steam and feed pipework. Condensing plant and feed heating systems.
(iii) Conveyor plant, coal handling systems and material handling of station auxiliary equipment.
Salary and conditions of service will be in accordance with the National Joint Board Agreement, Grade 5 (£567-£671 per annum) and Grade 6 (£433-£567 per annum) of Schedule "D" according to experience.

ENGINEERING DRAUGHTSMEN (ELECTRICAL)
Construction Department. Vacancy No. 61/53
Candidates should have experience in the preparation of layouts and diagrams for the installation of e.h.t. and l.t. switchgear, transformers, e.h.t. and l.t. cables, knowledge of protective gear systems would be an advantage.
The salary will be in accordance with Grade 5 (£567-£671 per annum) or Grade 6 (£433-£567 per annum) of Schedule "D" of the National Joint Board Agreement.

DRAUGHTSMEN
Transmission Department. Vacancy No. 156/53
Draughtsmen are required in the Transmission Department at Divisional Headquarters. Although not essential, candidates should preferably have had experience in one or more of the following: design and construction of high voltage sub-stations or overhead transmission lines and underground cable systems, civil engineering, electrical engineering, including lay-outs and diagrams for h.v. transformers and switchgear.
Salary and conditions of service will be in accordance with the National Joint Board Agreement, Grade 5 (£567-£671 per annum) and Grade 6 (£433-£567 per annum) of Schedule "D" according to experience.
The closing date for this appointment will be January 14, 1954.

JUNIOR ENGINEER
North Wilford Power Station. Vacancy No. 152/53
A suitable candidate will be given the opportunity to obtain operating and maintenance experience in the various sections of this large generating station operating at 850° F/600 lbs. sq. ins. steam conditions.
The initial salary will be in accordance with Class "K," Grade 15 (£545 per annum) of the National Joint Board Schedule.
Preference will be given to the candidates who hold the Higher National Certificate or who are at present pursuing a course of study with the object of obtaining this or a similar qualification.
The closing date for this appointment is January 14, 1954.

SHIFT CHARGE ENGINEERS
Drakelow Power Station. Vacancy No. 153/53
Applications are invited from suitably qualified engineers having had operating experience with large capacity, high pressure turbo-alternators and pulverised fuel fired boilers.
Applicants should be in possession of technical qualifications admitting to Corporate Membership of the Institution of Electrical Engineers and/or the Institution of Mechanical Engineers.
Apprenticeship at a large manufacturing works will be an advantage.
Salary, Class "J," Grade 7, £817-£852 per annum under the National Joint Board conditions of service.
The closing date for this appointment is January 14, 1954.
The above positions will be pensionable within the provisions of the British Electricity Authority and Area Boards Superannuation Scheme.
Applications should be submitted on the official form which may be obtained from the Divisional Establishments Officer, British Electricity Authority, Barker Gate, Nottingham, and should be returned to the undersigned by the dates stated. Please quote vacancy number.

L. F. JEFFREY,
Divisional Controller.
(G 251)

SOUTH WALES ELECTRICITY BOARD

REQUIRED, GENERAL ASSISTANT ENGINEER in District 461 (Pontypool) in the Eastern Sub-Area. Applicants should have sound experience of the layout and construction of mains and sub-stations in rural and urban areas.
Salary in accordance with Class "E," Grade 10 (£555 to £562 to £569) of N.J.B. Schedule.
Applications stating age, present position and salary, qualifications and experience and giving three referees, to be addressed to the Secretary to arrive by January 10, 1954.

D. G. DODDS,
St. Mellons, Secretary,
Cardiff. (G 249)

ASSISTANT ENGINEERS, experienced in the survey and construction of overhead transmission lines in Scotland, mainly wood pole types, but knowledge of tower work an advantage.—Give full details, age, experience, etc., to Box No. 920, Keith and Co., 137 Princes Street, Edinburgh. (G 242)

BRITISH ELECTRICITY AUTHORITY (Merseyside and North Wales Division) invite applications for the following appointments at the Connah's Quay Power Station, North Wales: INSTRUMENT ENGINEER. Salary £573-£596 per annum, Class "G," Grade 11, N.J.B. The successful applicant will be responsible for the efficient maintenance of all types of instruments associated with boilers and turbines. Possession of Higher National Certificate in Electrical Engineering would be an advantage. ASSISTANT MAINTENANCE ENGINEER (Electrical) and ASSISTANT MAINTENANCE ENGINEER (Mechanical). Salary for both appointments, £678-£704 per annum, Class "G," Grade 8, N.J.B. Applicants must have sound practical experience in the electrical or mechanical maintenance respectively, of modern power station plant. Associate membership of appropriate Institution or equivalent qualifications would be an advantage. All appointments superannuable and subject to medical examination. Application forms from the Divisional Secretary, Beaconsfield Road, Woolton, Liverpool. Closing date, January 11, 1954. (G 243)

ELECTRICAL ENGINEER required for electrical department of works in the north-east. Should have a sound practical training, drawing office experience, a knowledge of motor control gear resistance calculations, and preferably some experience of electrical heating for industrial applications.—Apply, giving full details of experience, technical qualifications, age, whether married or single and salary required to Box No. 3139, Electrical Times. (G 157)

ELECTRICAL ENGINEER required for editorial staff of the "Electrical Times." Previous editorial experience unnecessary, as successful applicant will be trained, but engineering qualification is essential. Age about 25.—Apply to the Editor, The Electrical Times, Ltd., Sardinia House, Sardinia Street, London W.C.2. (G 232)

ENGINEER required for development testing of control schemes involving electrical servomechanisms and electronics. Knowledge of machines necessary and applicants should possess H.N.C. or equivalent. Applicants with suitable qualifications but without experience will be considered.—Please reply to Box No. 3156, Electrical Times, quoting reference IDB. (G 250)

HANDLEY PAGE (READING) LTD., The Aerodrome, Woodley, Reading, have an immediate vacancy for a SENIOR AIRCRAFT ELECTRICAL DRAUGHTSMAN for work on an interesting new project. Only those who are fully experienced in all aspects of the work should apply, and for the successful applicant there will be suitable housing accommodation provided.—Please send full particulars of experience, etc., to the Personnel Officer. (G 26)

JOINTER (E.H.T.) required by London Electricity Board in Camberwell District. N.J.I.C. rates and conditions: 4s. per hour. Application forms from Secretary, 46 New Broad Street, E.C.2. Please enclose addressed envelope and quote Ref. M/2634/T. (G 255)

MINISTRY OF WORKS require a SENIOR ENGINEER (Site) at Calder Works, Windscale, Cumberland. Salary range £1,336-£1,476. Appointment is temporary. Requirements are British nationality, A.M.I.Mech.E. or A.M.I.E.E., and practical experience of supervising erection of medium pressure water tube steam boilers and turbo-alternator plant with responsibility for the subsequent commissioning. Duties: to supervise the erection and commissioning of reactor, boiler and turbo-alternator plant associated with electrical power generation from nuclear fission. Application forms from M.L.N.S., Technical and Scientific Register (K), 26 King Street, London, S.W.1, quoting Ref. C853/53A. Closing date January 15, 1954. (G 244)

BOX No. replies to be addressed to the ELECTRICAL TIMES, Sardinia House, Sardinia Street, London W.C.2

Engagement of persons must be made through a Local Labour Office or Scheduled Employment Agency, if the applicant is a man aged 18-64, or a woman aged 18-59; unless the person concerned is excepted or the employment is in a managerial or professional capacity, or is otherwise excepted from the provisions of the Notification of Vacancies Order, 1952.

OVERHEAD LINESMEN, wood pole, required for work in Central Scotland. Good hours and out-living allowances.—Apply to James Kilpatrick and Son, Ltd., Kelvin House, River Cart Walk, Paisley. (G 256)

PROGRESS IN MANUFACTURING METHODS and techniques in connection with a wide range of products from heavy power station equipment to electronic apparatus and development work on the products themselves, have led to several interesting vacancies in The English Electric Co. Ltd., Stafford, for MANUFACTURING or METHODS ENGINEERS and PRODUCT DEVELOPMENT ENGINEERS. Applications are invited from engineers working in either of these capacities and from those who have a sound background of practical experience in a manufacturing industry, at least O.N.C., and a desire to enter either of these important branches of engineering.—Please write, giving full details of qualifications and experience and quoting Ref. S.A. 36, to Dept. C.P.S., 336-7, Strand, W.C.2. (G 234)

SENIOR or JUNIOR DRAUGHTSMAN required for work on electrical power resistances and large electrical heaters for industrial applications. Previous experience on this class of work is desirable but not essential.—Apply, giving full details, including age, technical qualifications, whether married or single and salary required to Box No. 3137, Electrical Times. (G 156)

STATION ENGINEERS and STATION ENGINEERS (MECH.) required by Air Ministry at R.A.F. and M.C.A. stations. Minimum qualifications and experience: (a) Ordinary National Certificate in either electrical or mechanical engineering as appropriate or equivalent standard of technical education. (b) Recognised apprenticeship in either electrical and/or mechanical engineering. (c) Three years responsible engineering employment preferably on operation and maintenance of mine, factory or workshop plant and services. (d) Supervisory experience an advantage. Duties entirely supervisory and consist of installation, operation and maintenance of high and medium voltage distribution systems, electrical installations, diesel and boiler house plant, steam and hot water heating systems and miscellaneous installations, tools and equipment. Station Engineers' (Mech.) duties cover mechanical items only. Commencing salary according to age (normally £550 at age 28 or over), qualifications and experience on range £506 to £628, London. Provincial rates somewhat lower. Appointments include liability for service overseas for which special allowance payable in addition to salary. Appointments non-pensionable. Only natural born British subjects. Write, giving age, full details of qualifications and experience, to E.A. 1564, London Appointments Office, 1-6 Tavistock Square, W.C.1, by January 15, 1954. Only candidates selected for interview will be notified. No original testimonials should be sent. (G 245)

SWITCHGEAR ERECTION SUPERVISOR required for London area. Must be skilled fitter with experience in commissioning h.v. switchgear on site.—Applications stating experience and wage required to Box 1166, T and G 167 High Holborn, W.C.1. (G 233)

THE ENGLISH ELECTRIC CO. LTD., Stafford, requires experienced SENIOR and JUNIOR ENGINEERS fully conversant with the design of all types of rheostats and resistances for machines associated with generating plant and special industrial drives.—Applicants must be capable of working from machine data. Please apply, stating age, experience and salary required and quoting Ref. 1217A to Dept., C.P.S., 336-7 Strand, W.C.2. (G 236)

THE ENGLISH ELECTRIC CO., LTD., Stafford, has interesting vacancies for ENGINEERS to assist in the preparation of comprehensive tenders and contracts for hydro-electric schemes. Applications are invited from those having experience of this type of work and also from young engineering graduates or H.N.C. holders, who have a background of practical engineering experience, preferably with a commercial bias.—Please apply to Dept. C.P.S., 336-7 Strand, W.C.2, quoting Ref. 758A. (G 235)

THE GENERAL ELECTRIC CO., LTD., Magnet House, Kingsway, London W.C.2, have an opening for a SALES REPRESENTATIVE in the Persian Gulf area. General electrical engineering experience essential and some knowledge of electrical contracting work and administration an advantage. Age about 30 preferred.—Apply to the Staff Manager (Ref. P.G.), giving full details of record and experience. (G 229)

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One only Crompton Parkinson slipring motor, with short circuiting gear, 12·5 h.p., 400-440 V, 3 ph., revs. 930.
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Huddersfield Training College,
Queen Street South, Huddersfield, Yorks.

LONDON
The Principal (S/1/6),
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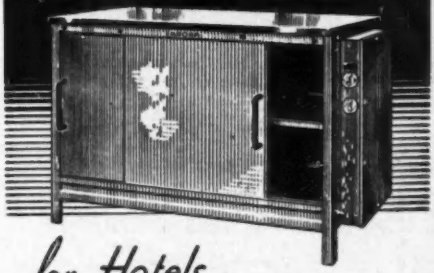

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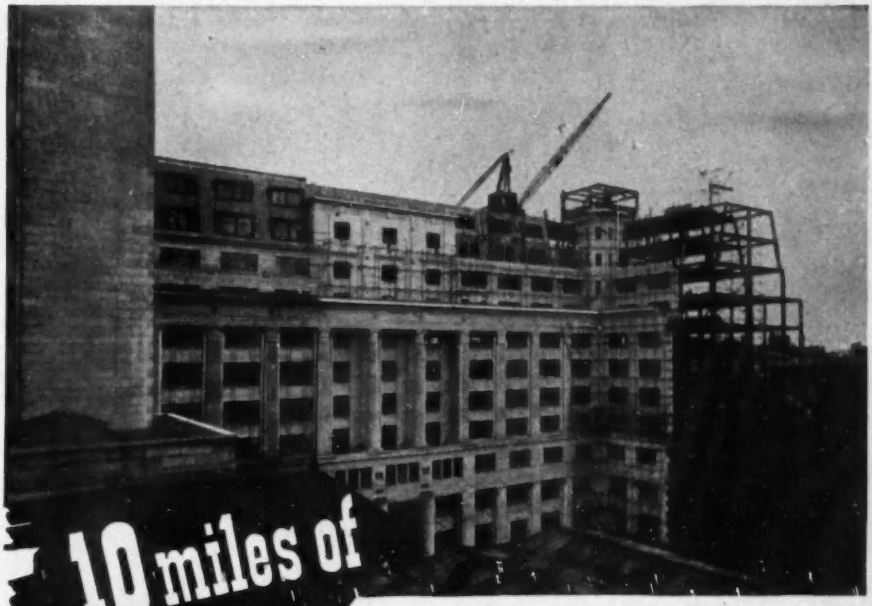

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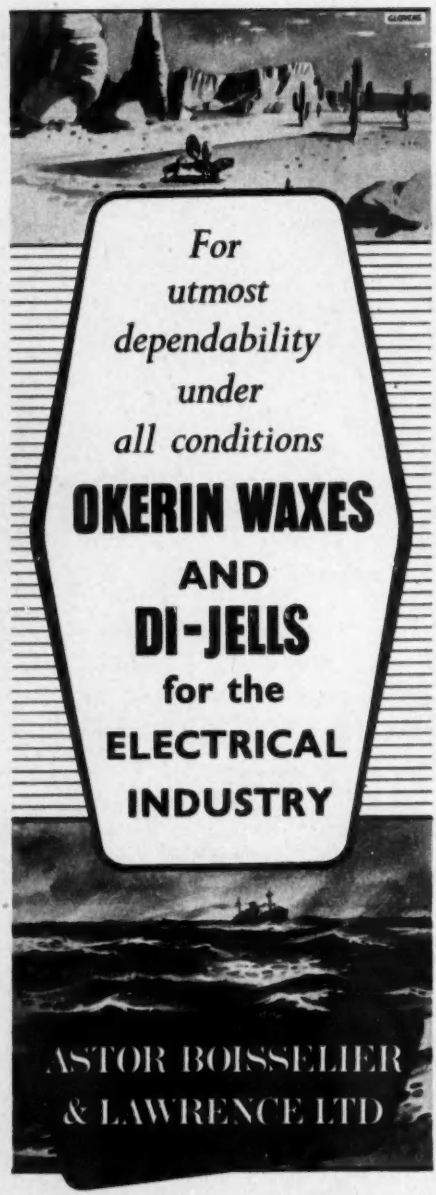

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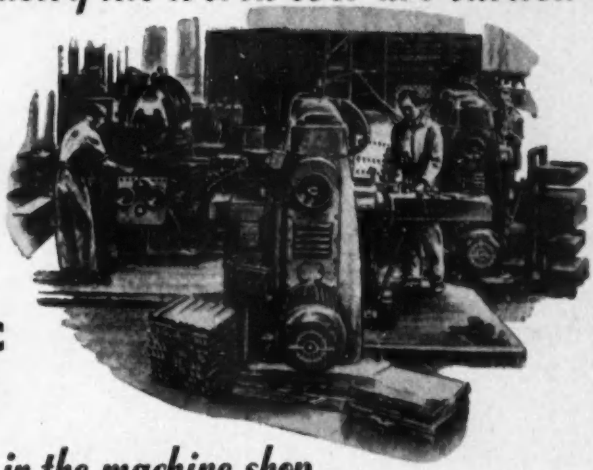

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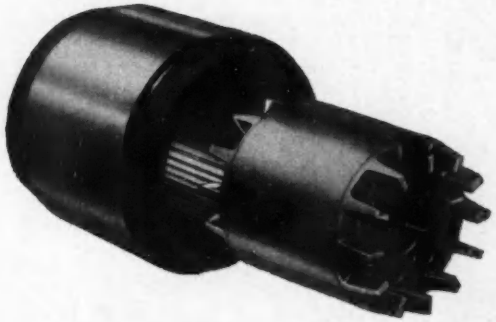

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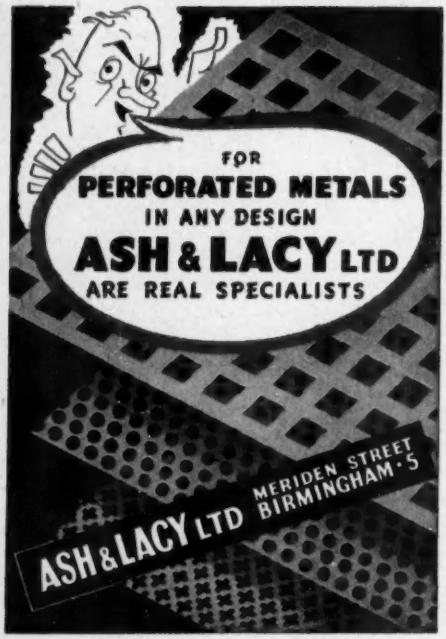

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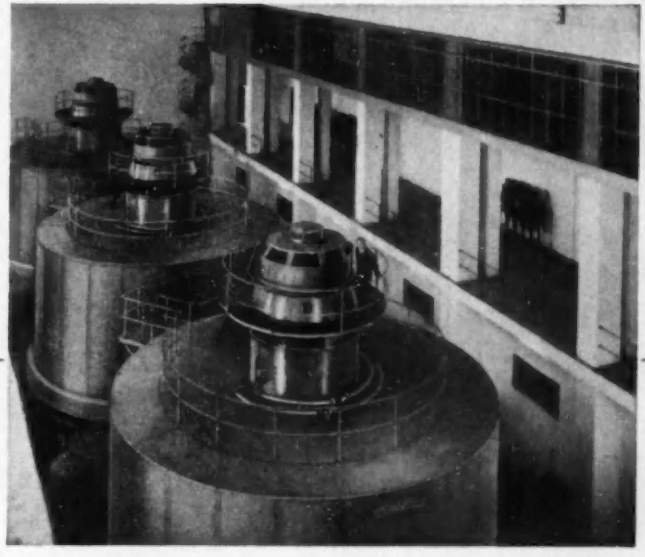

'ENGLISH ELECTRIC' supplied to S.A. Hidroelectrica Espanola the complete equipment for their Cofrentes Power Station. The illustration shows the three 46,000 kVA alternators, driven by 56,000 h.p. 300 r.p.m. vertical reaction water turbines which operate from a net head of 136 metres. In addition to the main units, 'ENGLISH ELECTRIC' supplied a 500 kVA auxiliary set.

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See the English Electric advertisement for Protective and Auxiliary Relays advertised on page 19 of this issue

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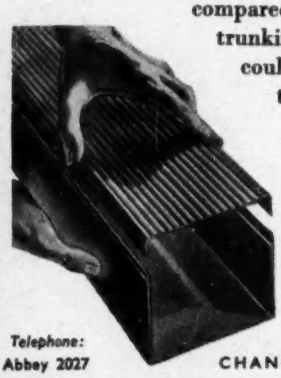
(*Nathan B. Forrest).



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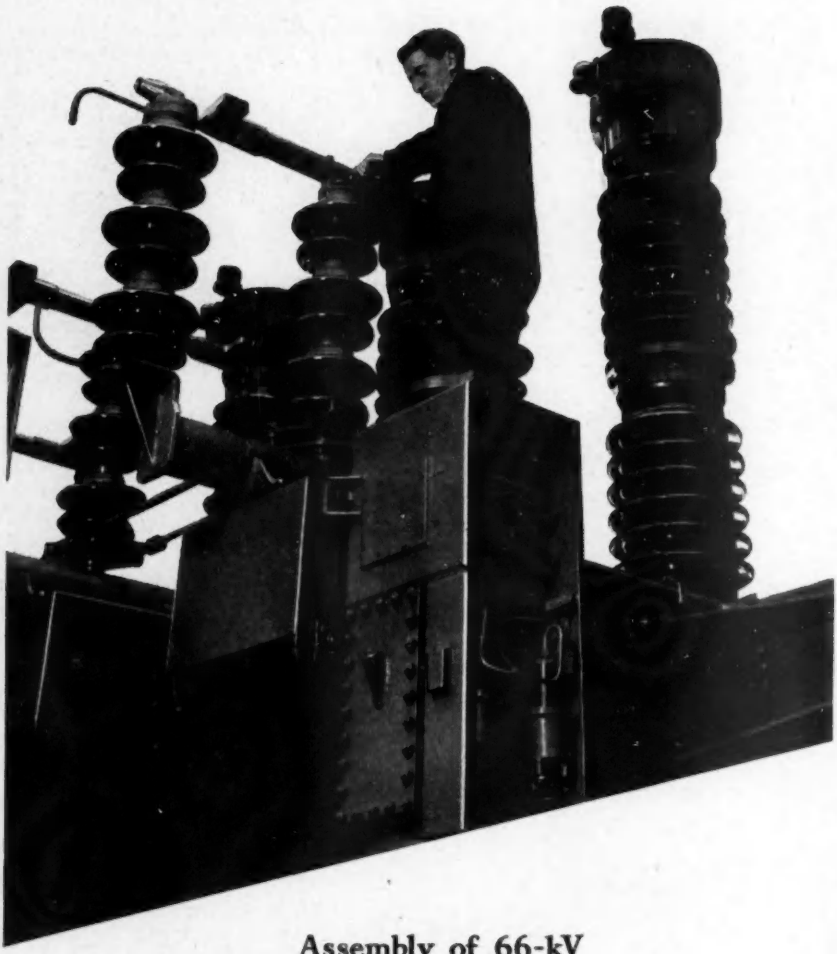

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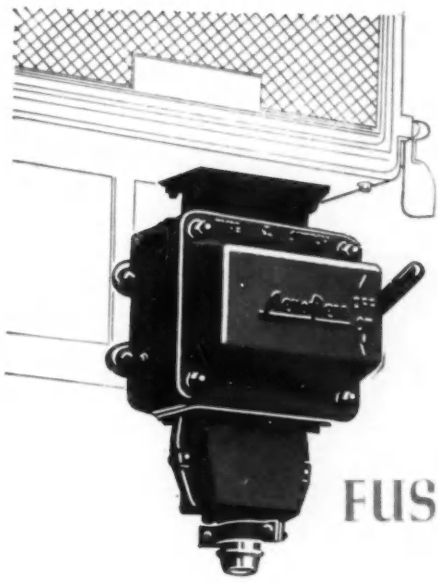

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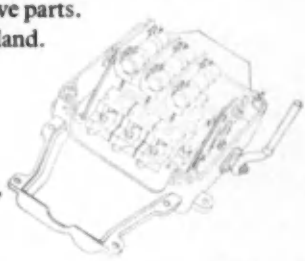

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